

POPULAR SCIENCE

OCTOBER • 35c *Monthly*

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PAGE 199



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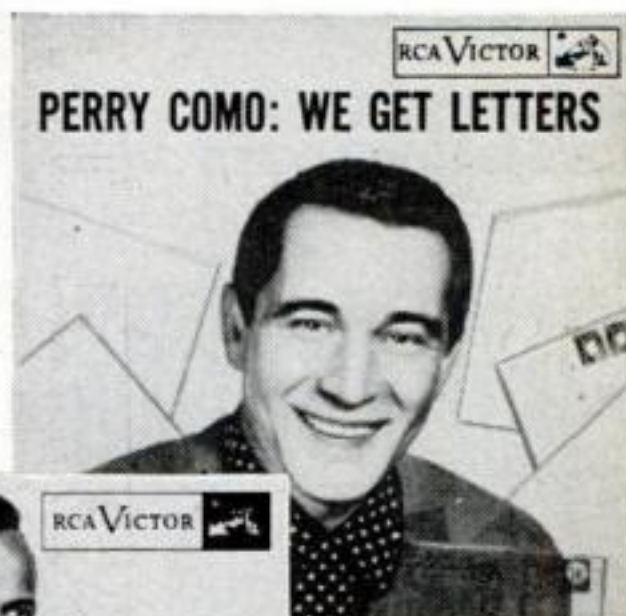
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Popular Science Monthly

October, 1958

Cover photograph by W. W. Morris



Hail to the '59 parade of cars! ... And what's new at Chrysler Corp.? Among other things, a swing-out seat to ease you in or out of those low, low jobs.

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Now ... listen to hi-fi with both ears! An expert takes the mystery out of stereo sound with a full report on how it works and what it can do for you.

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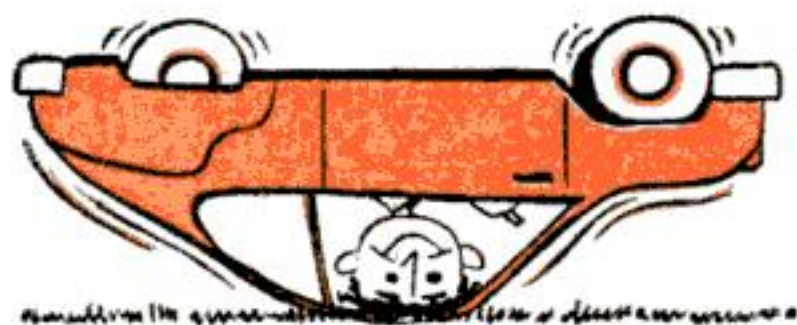
PS Readers

TALK BACK

Safety in Small Packages

JUST read "How Dangerous Are Those Small Cars?" [July]. You might be interested to know of several safety ideas built into the SAAB.

1. Rectangular tubes of great strength run from low in the body structure up through the windshield pillars. I have seen three SAAB cars that have rolled



over one or more times and not a single window cracked or broken.

2. There are no wrap-around front or rear windows. The back window appears small, but the body shell was designed and stress-tested with an allowance of just so much glass. SAAB is not prepared to increase it just to give the car more up-to-date styling.

3. The entire front of the car is made up of very heavy members—beyond other considerations, a necessity to support the engine, gear box and front-wheel drive. The platform frame is strengthened by heavy members running lengthwise at its outer edge and cross-braced by similar members. Thus passengers sit within a heavy reinforcement net.

4. The gas tank is placed low in the car and a bulkhead is erected just ahead of it to keep it from traveling into the passenger compartment in a crash.

J. BRUCE MCWILLIAMS, V.P.
SAAB Motors, Inc., NYC.

... BEING a Volkswagen owner, my first impulse was to drop your July issue on my driveway and run my car over it about 500 times. Then, being the typical superintelligent VW owner, I started thinking about THAT ARTICLE.

I've seen a Renault after it rolled a few times on the N.Y. Thruway and it looked pretty bad, but the driver wasn't hurt much. And I've seen a VW after it rolled

—not too much damage and the driver walked away. That's the way the cookies crumble.

Why do small cars roll so much? Generally the driver lacks experience in driving a car that does what he tells it to. In any small car not factory-equipped with a bottle of glue for the tires, hot-rodding car people tend to go a little too far with the gas pedal. They'll try one corner and come out okay. Then they take it from there until they get sopped up out of a telephone pole. Nine times out of 10 you can get a VW safely around corners faster than an American car—with experience.

W. M. DICKMAN, Clarence, N.Y.

Dog-Taming with Ammonia

THE reader with a cure for dogs that chase cars [July] has a grand idea by the tail, but he hasn't got the whole tale.

Ammonia, even when diluted in 10 parts water, is strong medicine. It can seriously damage a dog's eyes—as it would a human eye—and burn the dog's hide.

Caution: Don't squirt the water pistol directly at the dog. Make sure the mixture can't get into his eyes, ears, nose or mouth. He'll still scent it.

CECIL D. HARR, Caldwell, Idaho.

Flying Saucers Fly Again

SPEAKING of "unscientific phenomena" (ghosts, Bridie Murphy, flying saucers) the author of "Moon Men" [July] says that skepticism is a virtue. But let's not be a hammerhead.

There is no hoax in flying saucers, only a fear of belief. This "phenomenon" has been closely observed by very capable and



scientific men and is, by its nature, a very scientific machine, regardless of whatever else it may be. The multiple sightings by

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radar and camera plus simultaneous sightings by trained civilian and military men puts the UFO in a far different bracket than things testified to only by human perception.

RICHARD E. TODD, Duluth.

Jap Sub Was Biggest

LET us give credit where credit is due. Refuting a sentence in "World's Biggest Sub" [July], I quote from the June '50 U. S. Naval Institute Proceedings:

"Japan had five underseas carriers . . . the I-400, I-401 and I-402, each could carry three seaplanes and part of a fourth . . . each was 400 feet long, had a 40-foot beam and a surface displacement of 5,700 tons. They were far bigger than the ill-fated French giant Surcouf or the biggest American sub ever built, Argonaut."

A. UPSON, New Haven, Conn.

Correct. Before the Triton, Japan held the record for size.

Introducing the Oxynotus

I FOUND "What If You Meet a Shark" [July] excellent—and stimulating. The picture on page 2 captioned "Is this the grin of a man-eater? Meet Oxynotus" is keeping me awake nights. Not a paragraph in the story answers the question and I can't find this creature in my books. Can you help me? I still want to meet the Oxynotus—in print.



JACK L. COOPER, Sacramento.

The American Museum of Natural History (NYC) says the Oxynotus is not a man-eater. You can meet him in person in the Eastern Atlantic, the Mediterranean and in the waters around Australia.

Footnote on Transaxles

I'LL have to read "Next Big Change in Cars: Flatter Floors" [July] three or four times to soak up all the details. In the meantime, one thought:

Why not put the engine in the rear, the transaxles in the front? Cars today have only one control to the engine—the combination ignition switch and starter. Electrical circuits are cheaper to run from

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"The accounting profession is probably the best in the world. If there be a profession in which compensation is higher, it is not known."
"There is ample demand for accountants. There is no prospect of supply will overtake the demand within the near future."
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front to rear than transmission controls. And weight distribution would be a lot better, too.

GI trucks use front drive and steer darn good (hasn't everybody got power steering?). As for station wagons—you can move freight in a truck or a train.

HAROLD M. STRICKER, Memphis.

Spray Fixers Get Help

THERE is no question as to the clarity of your article "Timely Facts About Automatic Sprays" [June]. Whereas we previously received vague inquiries on automatic sprays, we now get precise questions. Reference is so often made to the article that we now realize how quickly POPULAR SCIENCE "gets around."

F. K. ROBERTSON, Automatic Spray Service Center, Los Angeles.

Wanted: One Thermoelectric Unit

I HAVE just read your highly interesting piece, "Electricity Without Generators" [Aug.]. Can one buy thermoelectric units as yet?

Your "Window on Tomorrow" section promises to become one of the most

needed approaches to whet the appetite of the public for more informative and exemplary scientific material.

BLAIR S. ALDEN, V.P.

Blairco Industries Inc., Olney, Ill.

As far as we know, no one has thermoelectric devices for sale now, although Westinghouse presumably will shortly. For latest "Lab news," see "Reversing Hot-and-Cold Machine" on page 96.

False Alarm

YOU goofed in the article, "New Fire Engine Drives Like the Family Car" [Aug.]. On a photograph of the control panel on the new American LaFrance pumper, the items marked 2½" hose inlet are discharge outlets. That labeled 2½" hose discharge is a suction inlet.

J. A. TOWNES JR., Minter City, Miss.

Like a lot of the volunteer firemen who caught the error, we are burned up, too.



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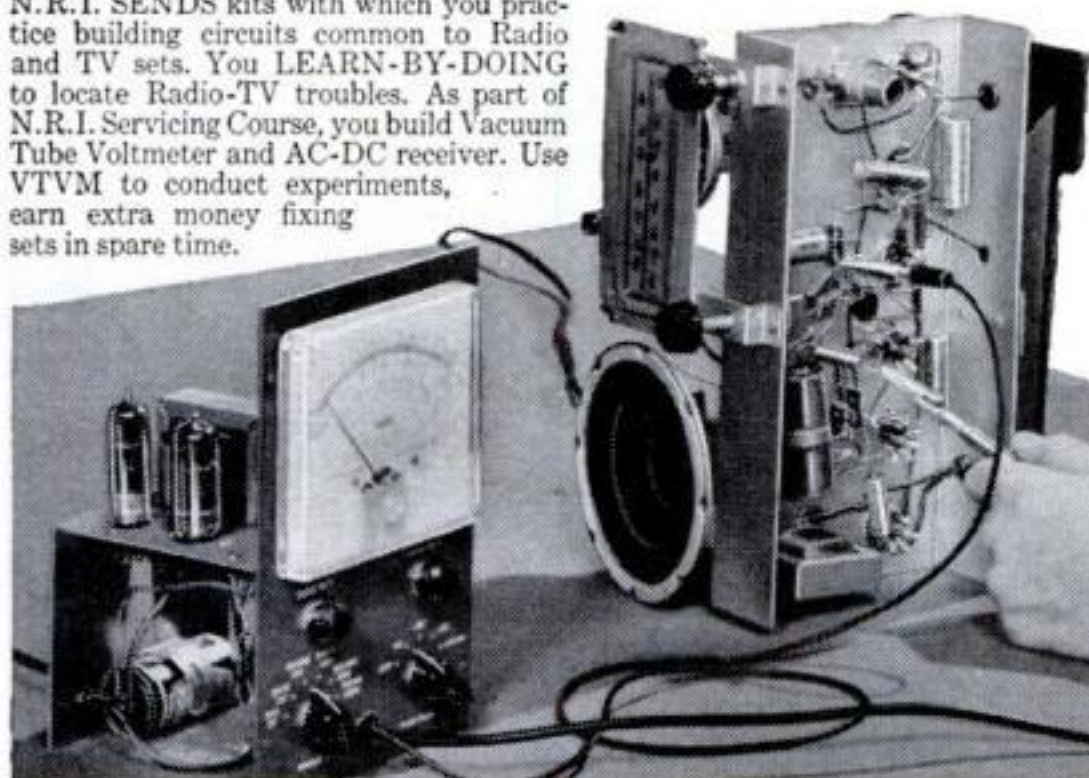
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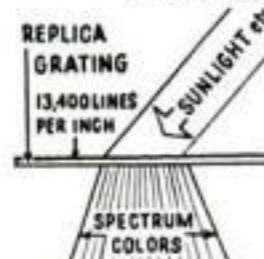
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The month in science

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Machines that learn. Scientists are ready now to provide mankind with real mechanical slaves: smart electronic robots to take over the intellectual grind of reading, writing, observing, translating. They will be inanimate brains, imitating human thought, and as superior to present electronic computers as computers are to cigar-store cash registers.

The big difference: They will be able to learn.

Today's computers are morons. Lightning-fast, but still morons. They can do only what they are told to do in precisely the way they are told to do it. For many pressing jobs (like translating languages), it is more difficult to figure out instructions for a computer than it is to hire people to do the job.

The new intelligent machines will not need instructions. They will not even need to know precisely what the job is. They will be fed raw data—printed words, pictures, electric signals—and standards for knowing when they come up with right answers. They will *learn* to get the right answers themselves by trying one method after another.

Incredible? Two experimental breadboards have been rigged up. They work. They actually learn.

Last year Harvard's R. M. Friedberg wired an IBM 704 computer into three parts:

- ▶ Herman, who did the work;
- ▶ Learner, who told Herman what steps to follow;
- ▶ Teacher, who told Learner when Herman got the right answer fast enough.

The job was simple. Herman had to deliver in a specific location the same digit (zero or one) that was given him in a different location. But remember: Neither Herman nor Learner knew what the job was.

Herman went to work blindly, trying one after another of the 18 billion billion methods Learner might supply at any one moment. The idea was the same as giving a monkey a typewriter and waiting for him to type out Shakespeare's sonnets.

Not quite, though. Herman was faster than a monkey (he could try 10,000 "programs" a minute) and smarter (he could remember parts of programs that gave the right answers).

It took Herman six minutes to learn that he had to work fast. By then he was right half the time (pure chance). In 10 more minutes he hit on a "perfect program"—and thereafter delivered a correct answer every time. He had learned how to solve the problem.

This year the Navy demonstrated Perceptron (again on an IBM 704), "so like a human being without life" that it shouldn't be called a machine. It can recognize its surroundings. In the test,

The month in science

Perceptron learned to tell right from left after only 100 trials.

The first specially built Perceptron, ready next year, will have 400 photocells for eyes and 1,000 electronic "association cells." It will learn to read and write.

Later models will learn to recognize people and call out their names, and eventually, to translate languages.

Perceptron will cost only \$100,000 ("only" compared to the IBM 704's \$2,000,000). Will really cheap learning machines be made? How about a brain that can learn to drive—always safely, always efficiently? Could be.

Threescore years and ten—but no more. Modern medicine has fulfilled the Biblical promise (Psalms 90:10) of a 70-year life span. And there it seems to be stuck.

Average life expectancy is leveling off after 50 years of spectacular gains. In 1900, it was less than 50. By 1954 it went past 69. But since then it has changed little.

One reason: Medicine's great victory is conquest of infectious diseases, which are most deadly to the young. So nowadays far more babies live to grow old, building up the average.

The figures are dramatic. In 1900, one baby out of four was expected to die before his 25th birthday. The expectation now is one out of 20.

Medicine has been less successful at lengthening the life of people who survive childhood. Life expectancy for 25-year-olds is now 8½ years more than it was in 1900, for 65-year-olds only two years better.

The stumbling blocks are cancer and heart disease, which kill older people. Progress here is heartening. Many experts guardedly predict an early victory over cancer.

One promising development: A blood test for cancer (discovered in Japan). It spots in the bloodstream a compound that seems to come only from cancerous tissue.

If this proves out, it will be a great stride forward, since cancer can be cured when diagnosed soon enough. Then you'll see life expectancy jump ahead again, beyond threescore and ten.

Making screwworms commit race suicide. U.S. farmers will be rid of this multimillion-dollar pest (it looks vaguely like a screw, kills livestock), thanks to a cute but sort of dirty trick. The Department of Agriculture will release male flies sterilized by atomic rays. The females mate only once, but the males are promiscuous. The presence of sterile males cuts the screwworm birthrate to pieces. After a few seasons, the bugs are gone.

Walter Mann

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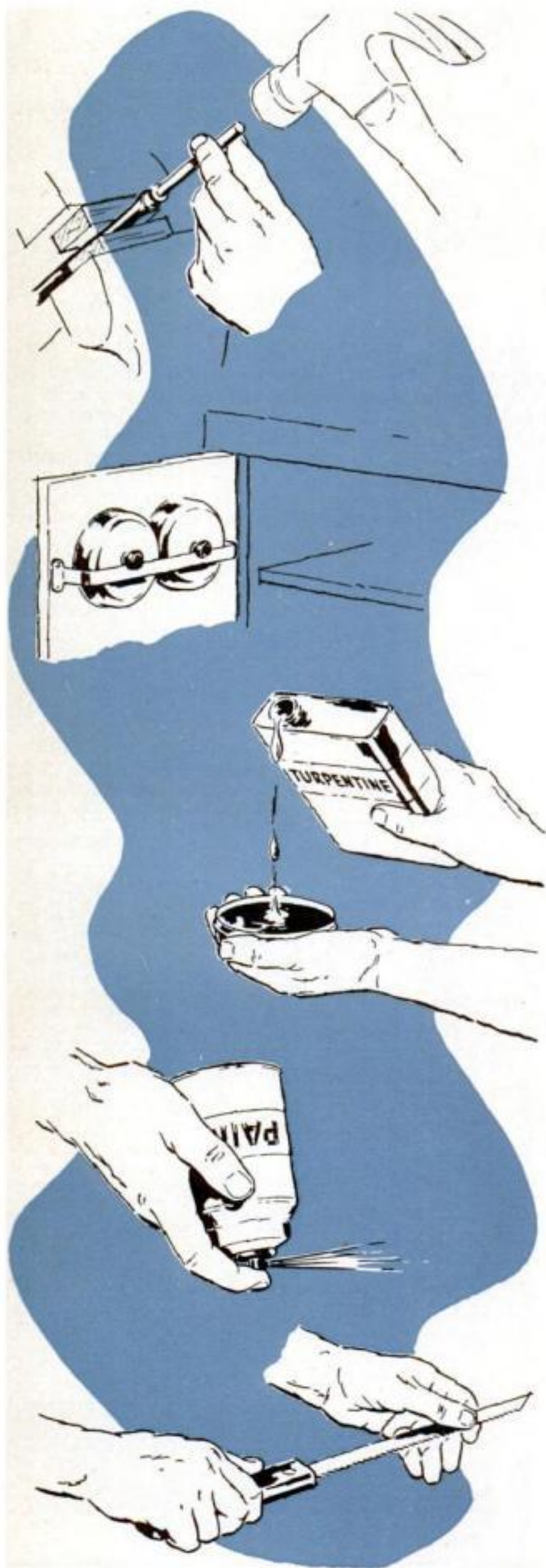
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2 A penny-saving rack to store pot covers on the back of a door can be made in minutes. Cut a flat curtain rod to fit the width of the door; or use a 2"-wide strip of aluminum bent over at the top to form a nonscratching surface.

3 If shoe polish hardens and crumbles in the can, don't throw it away. Soften it again by dampening it slightly with a scant sprinkling of turpentine and it will be good for many more shines.

4 There's less waste if you hold a paint-spray can upside down and depress the nozzle valve for a second or two before storing the can. The short burst of gas clears the nozzle opening and prevents the clogging that often occurs if paint dries inside it. When the can is upside down, a standpipe prevents paint from entering the nozzle.

5 Save the handle when a butcher knife ends its days. Fit it with an old blade from a power hacksaw and you've got a combination kitchen knife and bone saw. Grind the back of the blade to a knife edge (don't overheat it or you'll spoil the temper) and shape the point to suit you. One rivet hole for the handle is already there; the others can be made with a small carbide-tip drill. Get new rivets at your hardware store.

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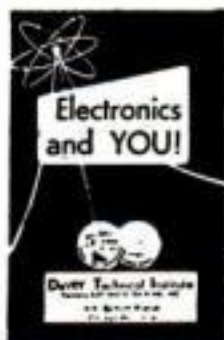
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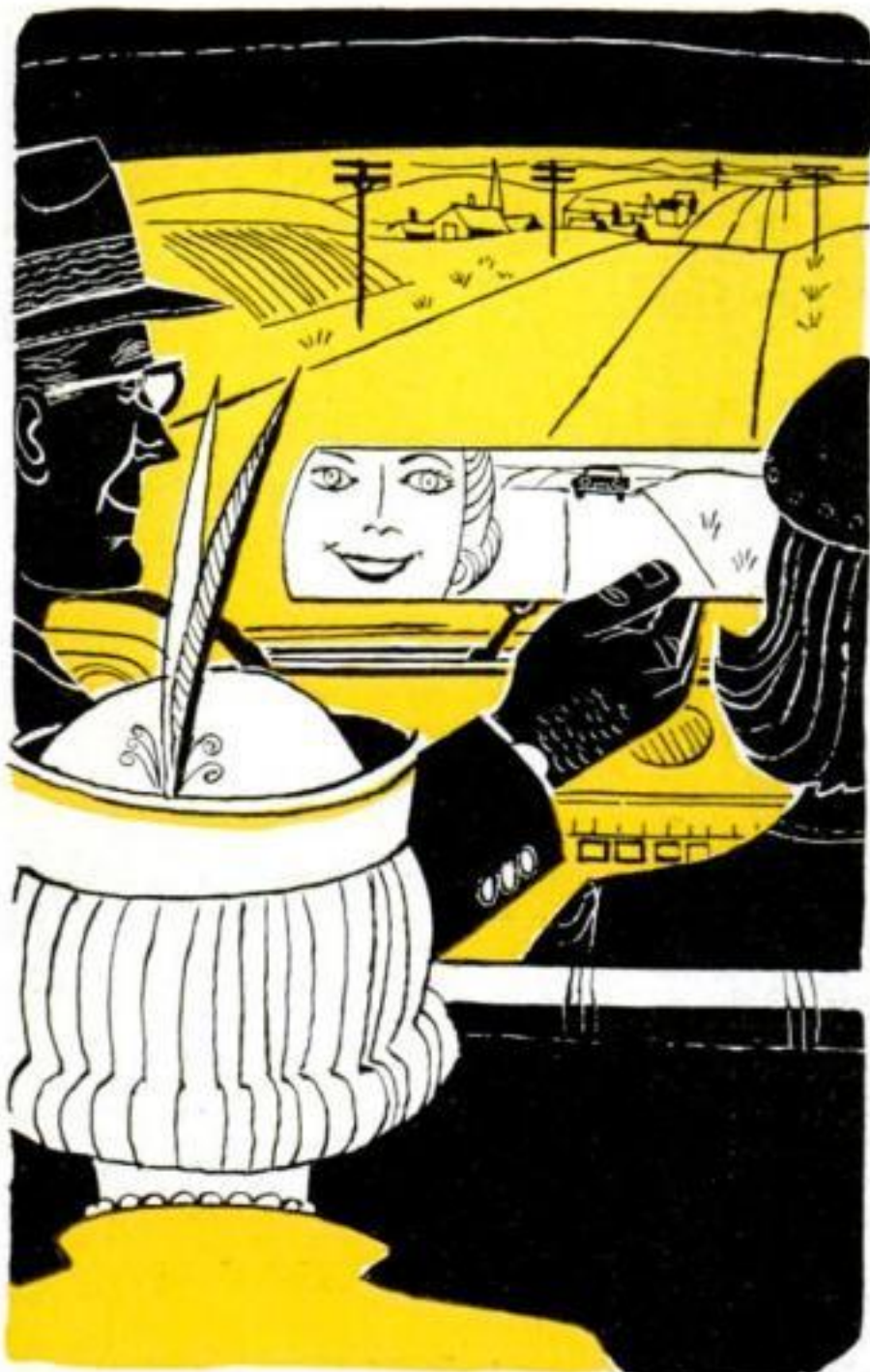
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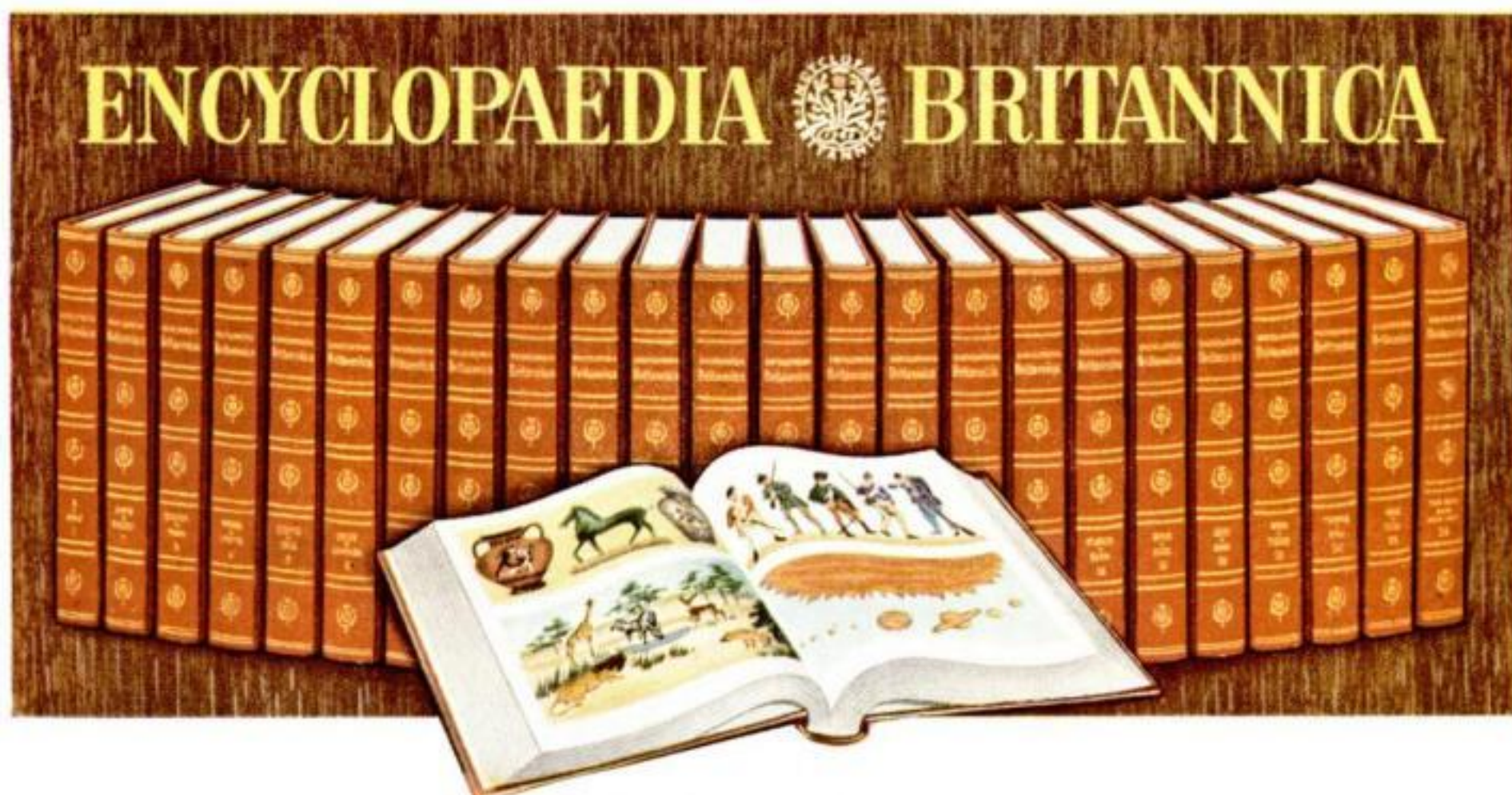


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Packard name mothballed. Only 1,400-odd customers bought Packards in the first half of the 1958 model year. There'll be no 1959s. This marks the apparent end of one of the oldest surviving auto names (Olds is older). Company officials, hinting that current obituaries may be premature, suggest that if business takes an upturn, Packard name could be revived.

Packard as a car actually expired in 1956, when it became a Studebaker in sheep's clothing. The car's heyday was in the Twenties and Thirties. Distinctions included lavishly engineered straight eights and V-12s, first hypoid axle, first air conditioning. Packard was also the first U. S. car to have a steering wheel—earlier ones had tillers.

Barnum was right. A weirdly improbable but profitable racket was uncovered in Michigan recently. Its gimmick was an ordinary white rat, described as "the mortar rat that eats mortar from between the bricks, which makes your chimney unsafe."

A fast-talking "chimney inspector" conned householders into letting him check fireplaces and furnace flues. He'd pull out a palmed white rat, then sell the alarmed and gullible home owner a costly recementing job. When the cops nabbed one crew, they found in the truck a supply of spare white rats.

"Planned obsolescence" of appliances may be on way out. With customers hanging back, big appliance makers are scratching for ways to cut costs. One possibility: abandonment of the practice of yearly model change.

Though supposed to stimulate sales—to make housewives yearn for the newest, fanciest washer-dryers or refrigerators—this change runs up manufacturing costs. Design and engineering expense per unit is higher; tooling and dies have to be written off over shorter production runs. Annual change makes trouble for the retailer, too: slow clean-up of last year's model, bigger stocks of repair parts.

No general abandonment of annual changes is certain now. But Easy and Whirlpool are planning to drop yearly models; Maytag has already done so; GE is reportedly studying it.

Big Brother Detroit is watching you. Reception (and more important: sales) of new cars coming out now is being very, very carefully analyzed by motor makers. Reason: A number of makes were trapped—by the requirements of long lead time—into bringing out 1959 models that may not suit 1959 tastes. If this is true (only sales will show it), now is none too soon to begin replanning 1961 cars.

Another reason for close scrutiny of customer reaction: The domestic little-car programs are coming up on their cut-off points. At present the "Mini-Ford" (code-named the "XK Thunderbird Program" by the factory) is farthest along, being aimed at public unveiling by August, 1959. Car somewhat resembles a slightly shrunken 1949 Ford, has a small OHV 6 in front, conventional

You ought to know...

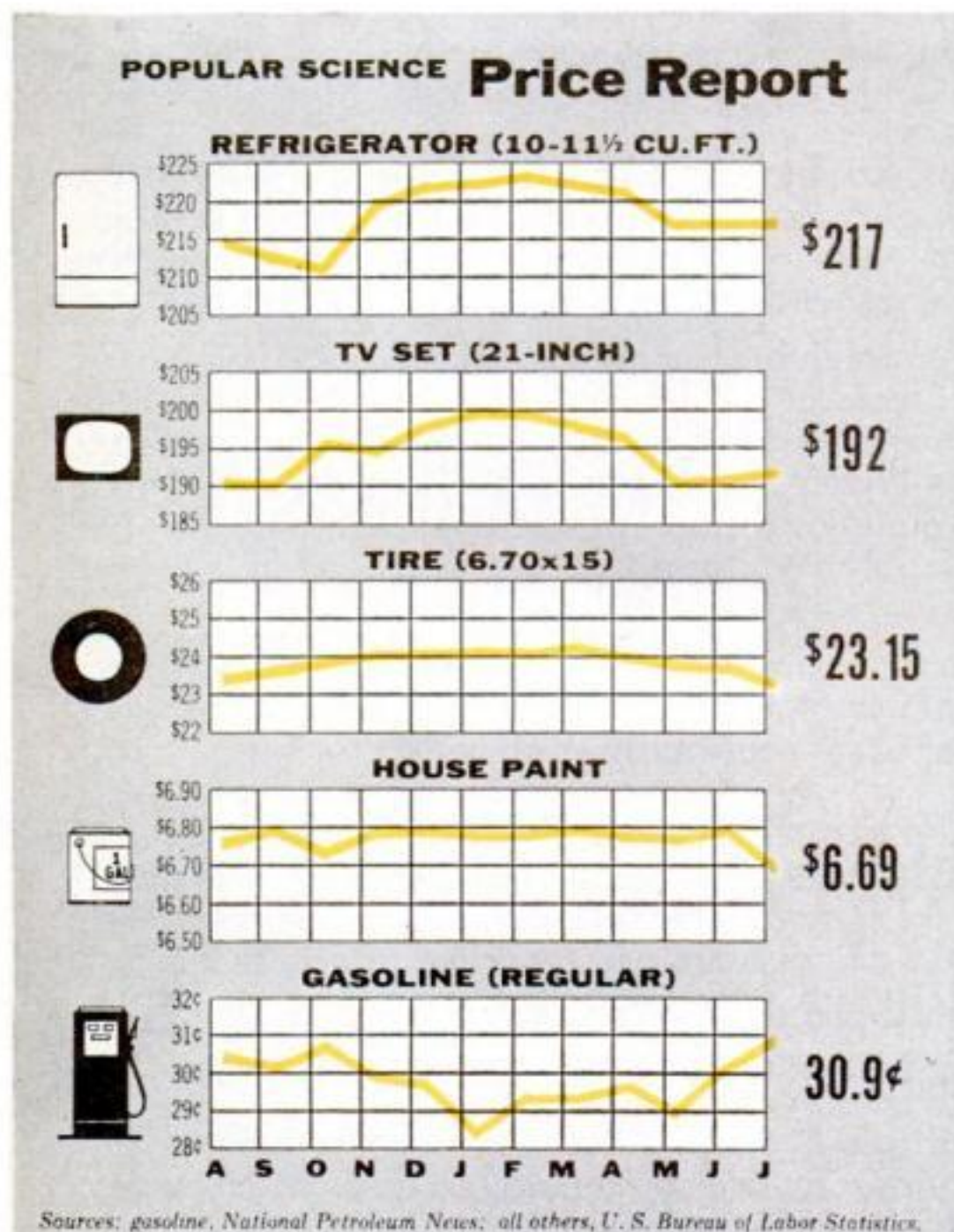
rear-wheel drive. "Mini-Chevy," a rear-engined flat six, is not as far along, being more radical.

But if the public queues up to buy the 1959 standard cars in heartening numbers, both programs could still be washed out. Some of the considerable investment could be recovered by sending the designs and tooling to overseas subsidiaries.

What do motorists really believe about safety? A new "depth study" of driver motivations (including typical attitudes toward judges, cops and traffic laws) has unearthed some facts well worth pondering by safety experts:

- ▶ Nobody thinks he is an average driver. Nine out of 10 adults believe that they are better than average.
- ▶ This high percentage of secret vanity goes higher yet with drivers having a record of traffic violations. A full 100 percent of such drivers interviewed rated themselves as better than average.

Possible significance: Conventional safety campaigns—slogans, publicity about highway deaths, and the like—may be missing the target. If almost everybody thinks he's better than average, it's easy to slip into the accidents-happen-to-other-people fallacy.

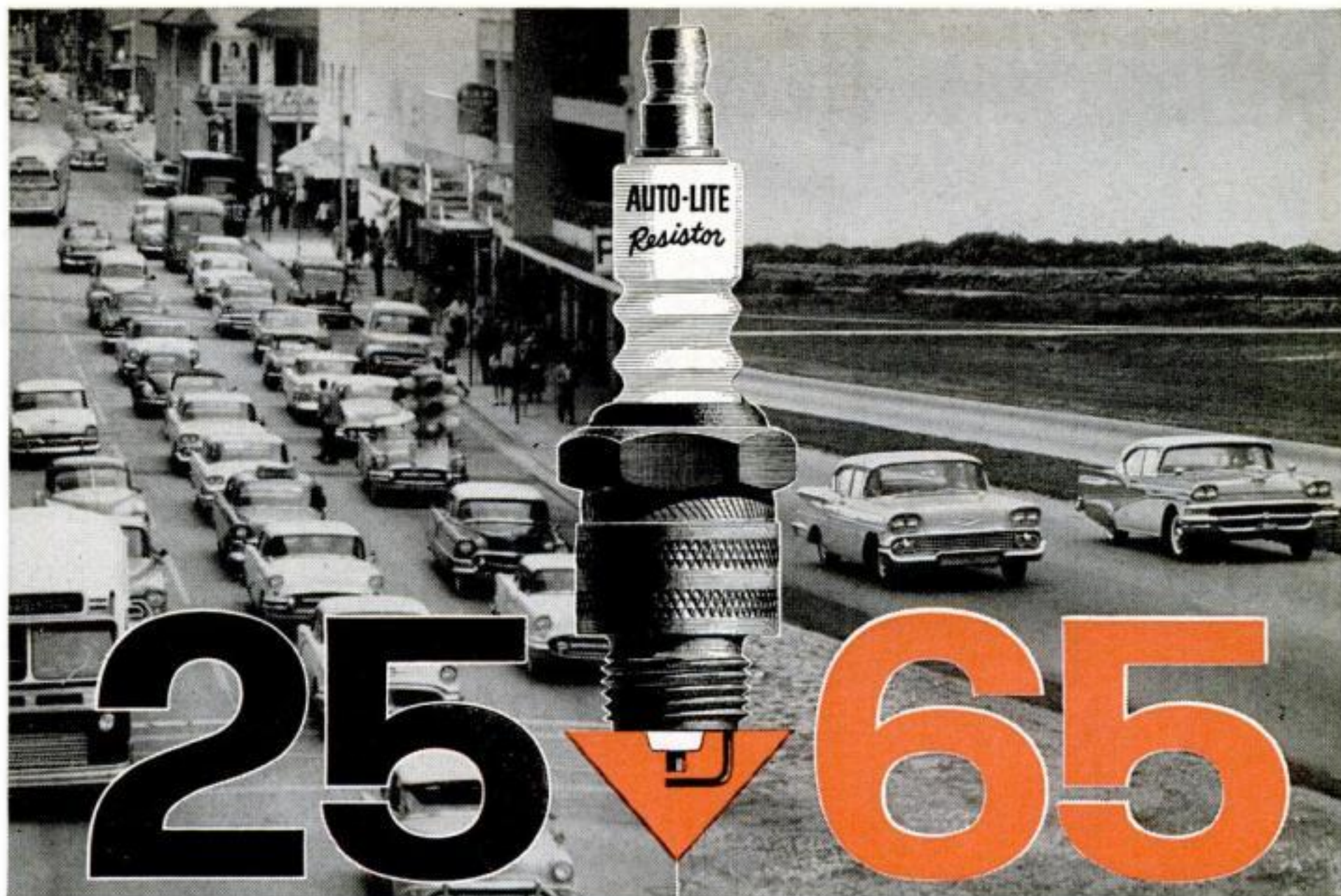


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While drivers give lip-service approval to almost all traffic laws, there are only two violations that get people really worked up: speeding and drunken driving. Interviewers found that even here, indignation was reserved for flagrant, not technical, violations—not just five m.p.h. over the speed limit, not just one or two drinks.

Cops got better marks than traffic judges. More than half the drivers studied thought that many judges weren't properly qualified for their jobs.

On the other hand, about half the motorists praised the local police force, rating it as "one of the best you'll find anywhere."



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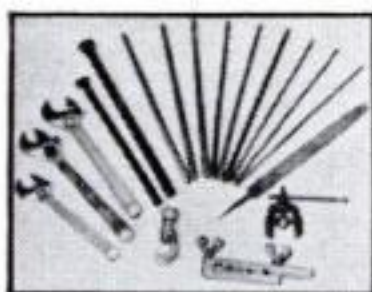
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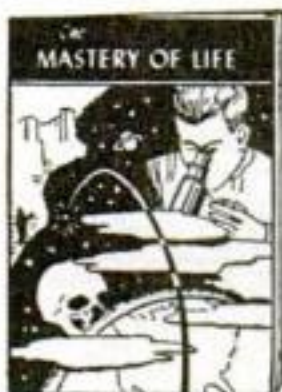
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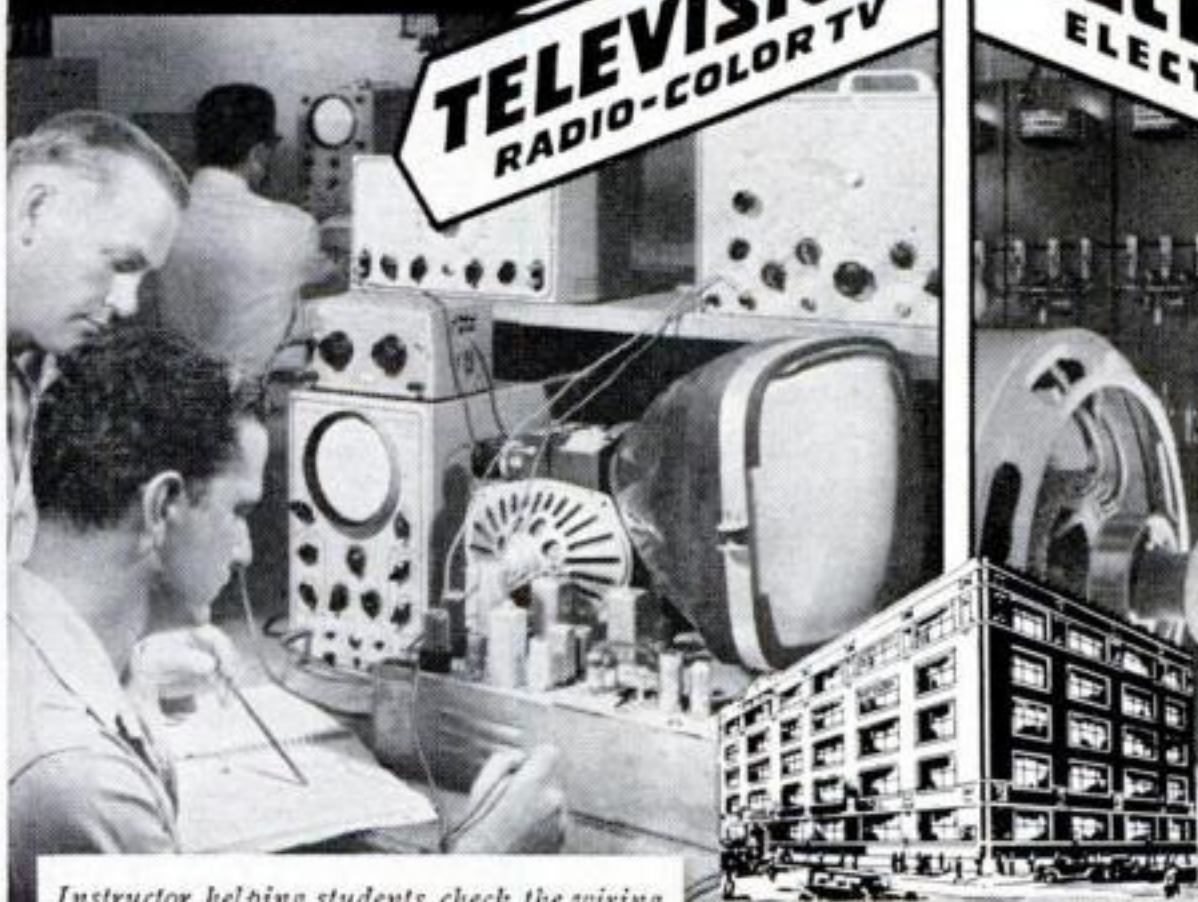
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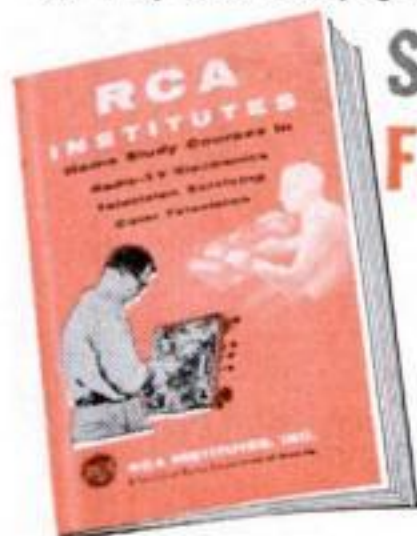
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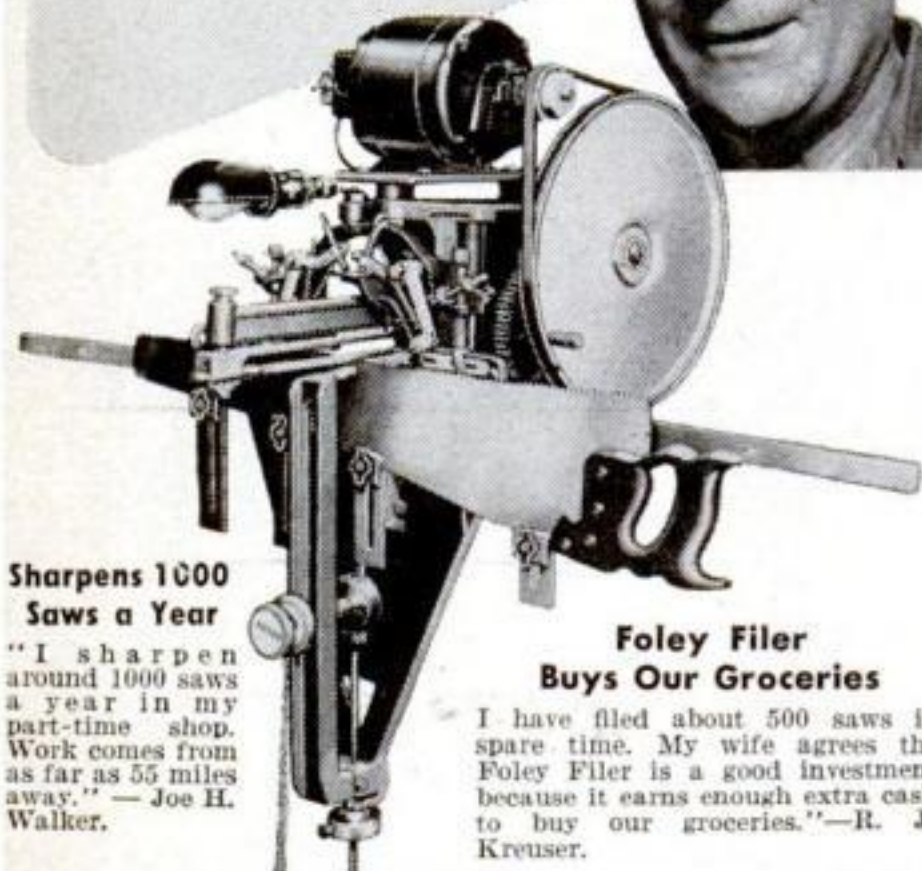
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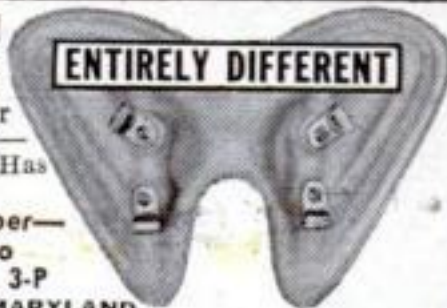
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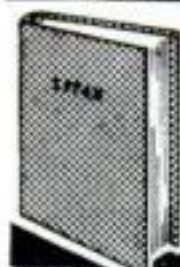
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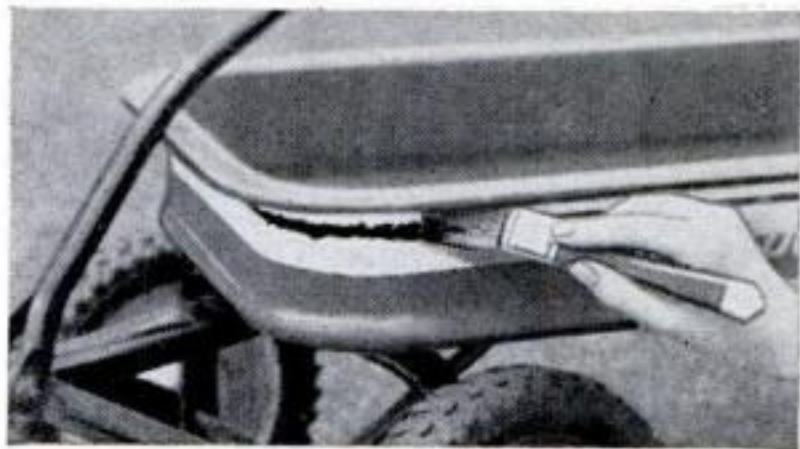
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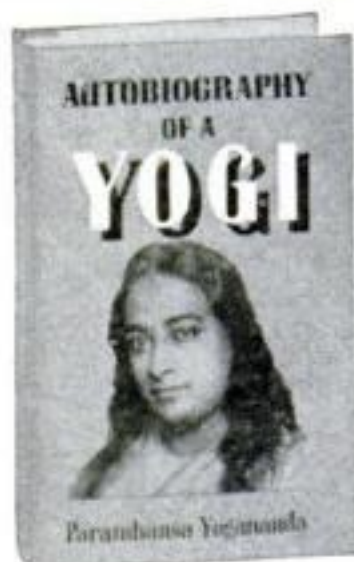
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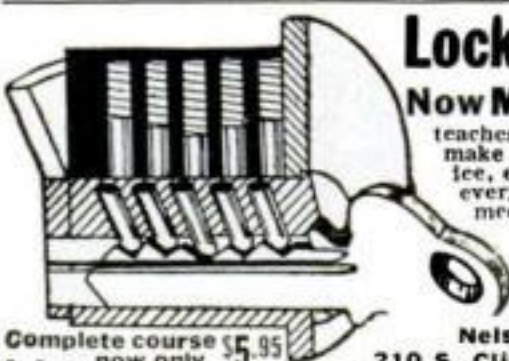
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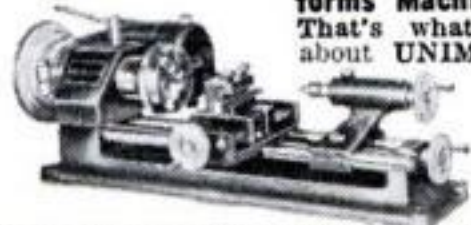
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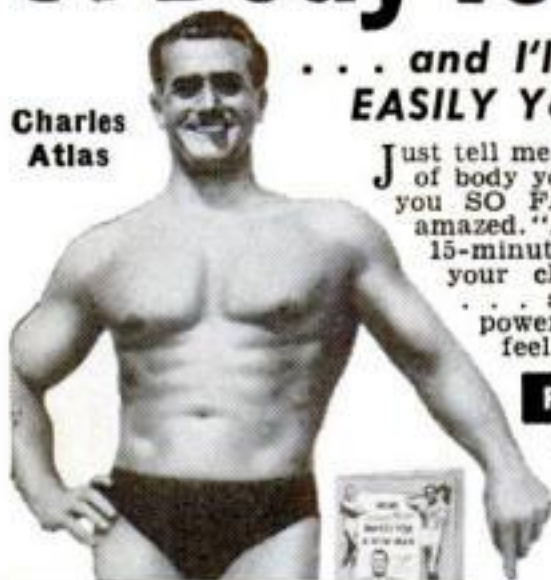
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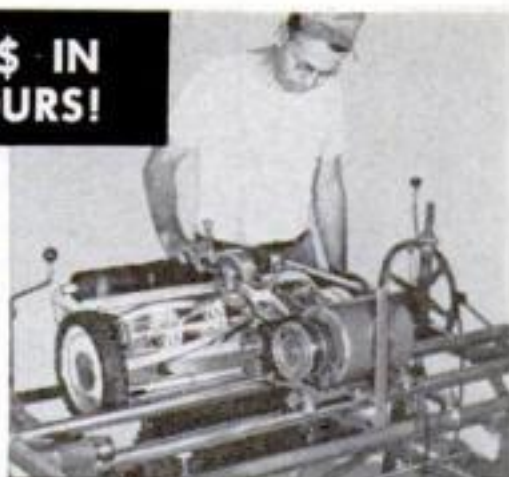
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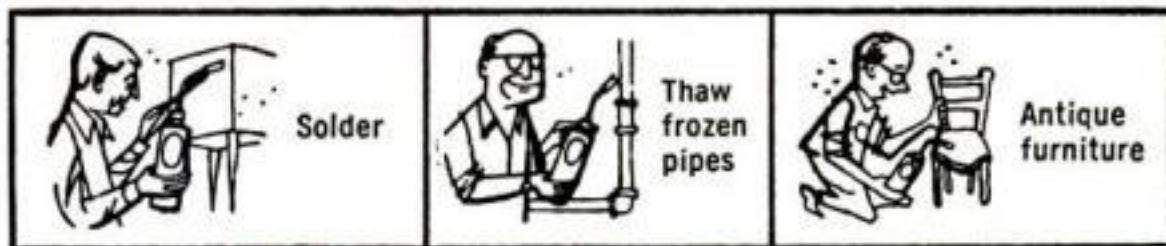
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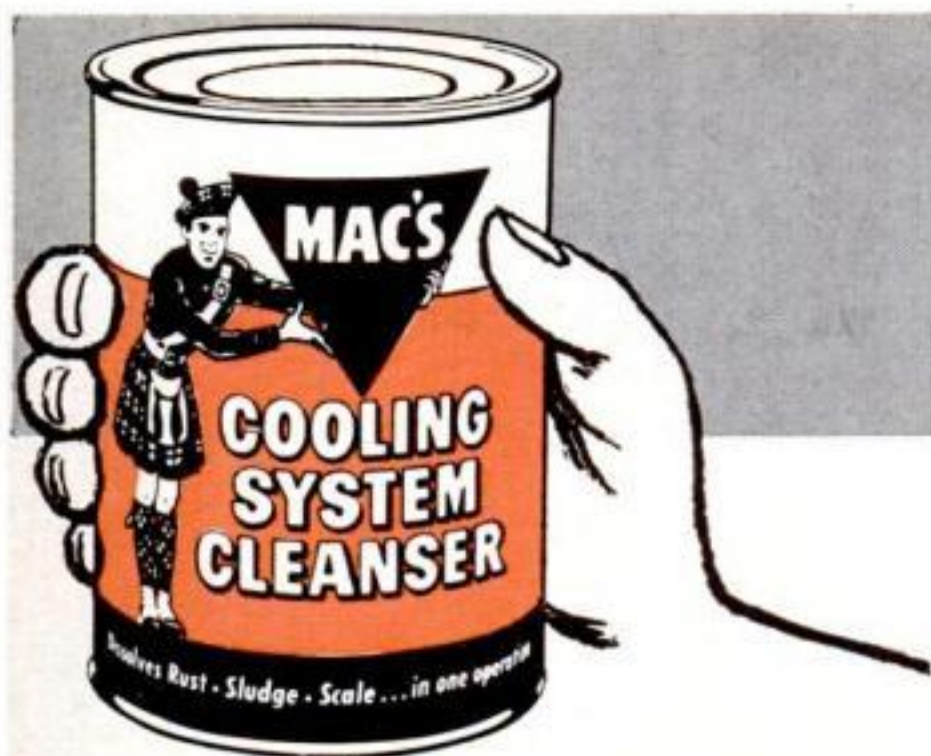
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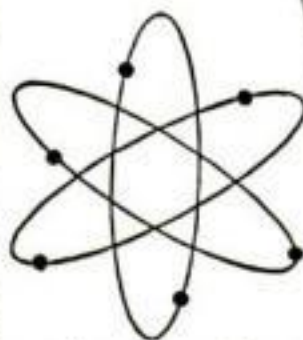


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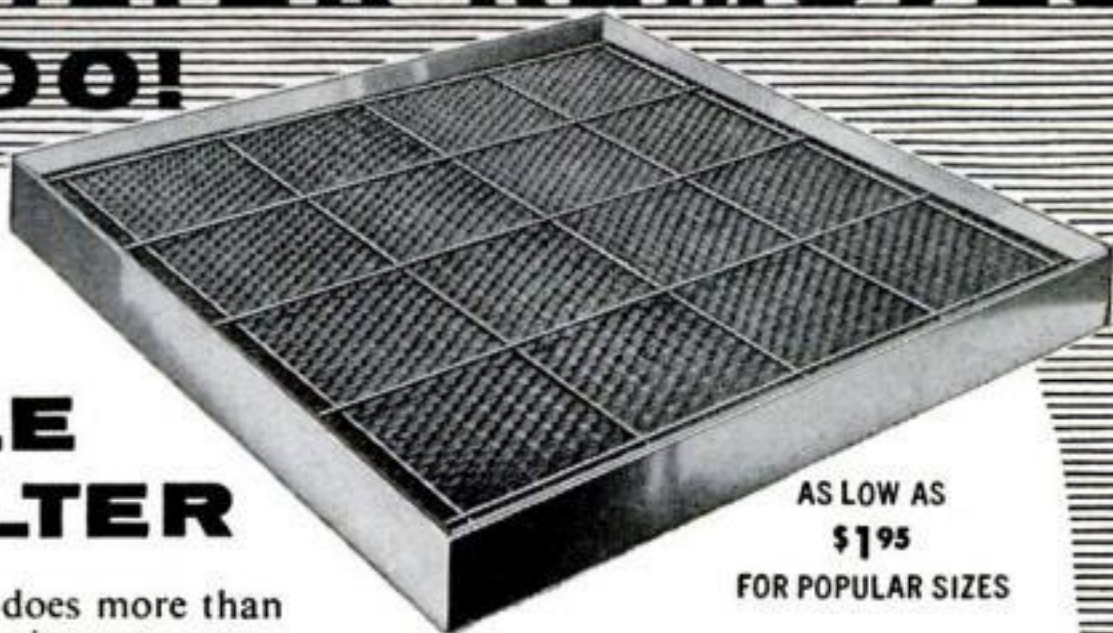
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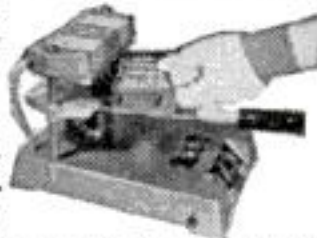
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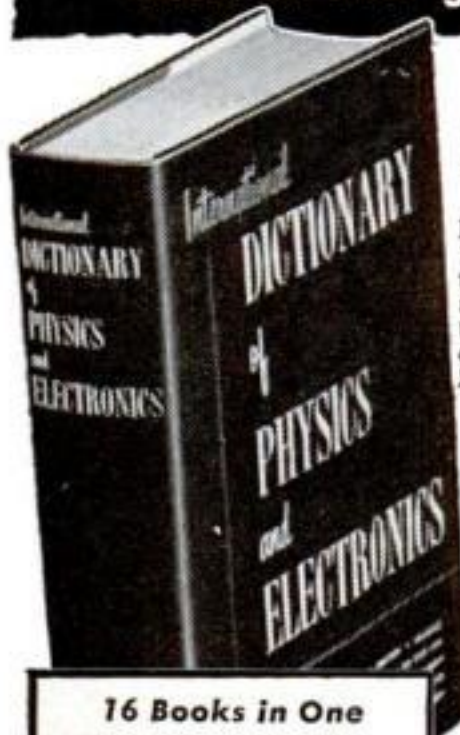
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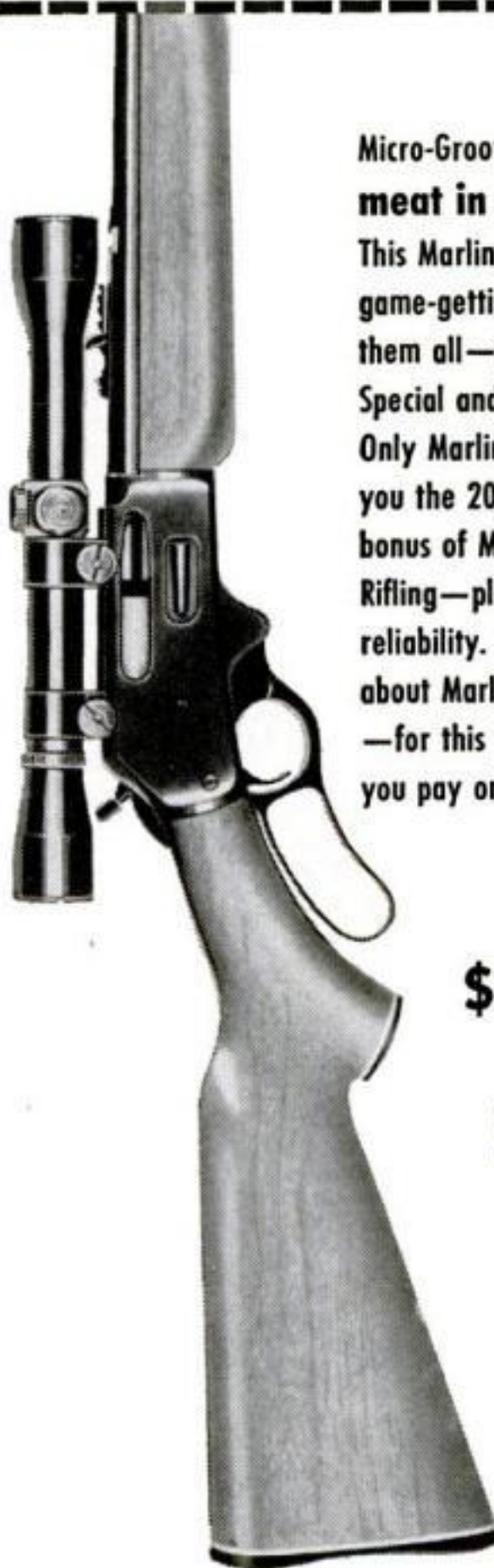
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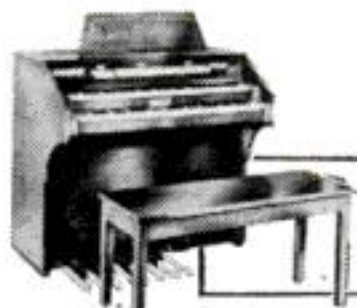
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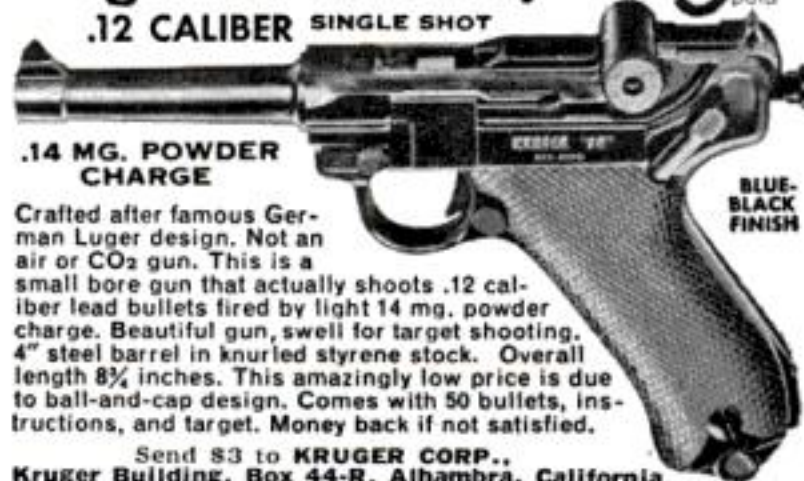


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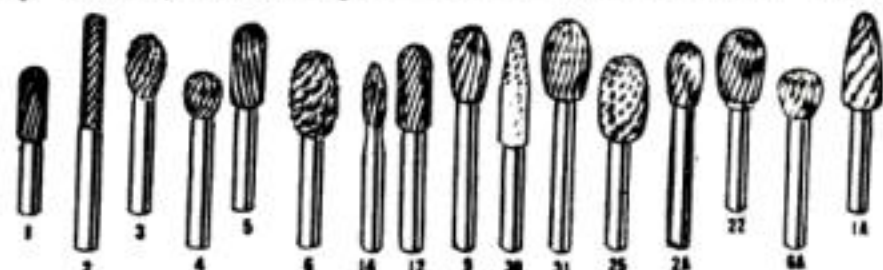


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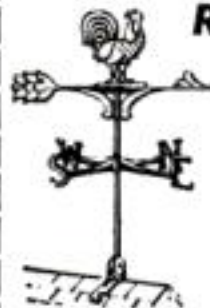


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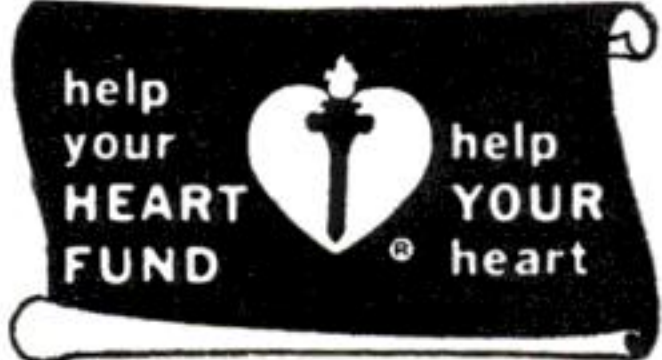
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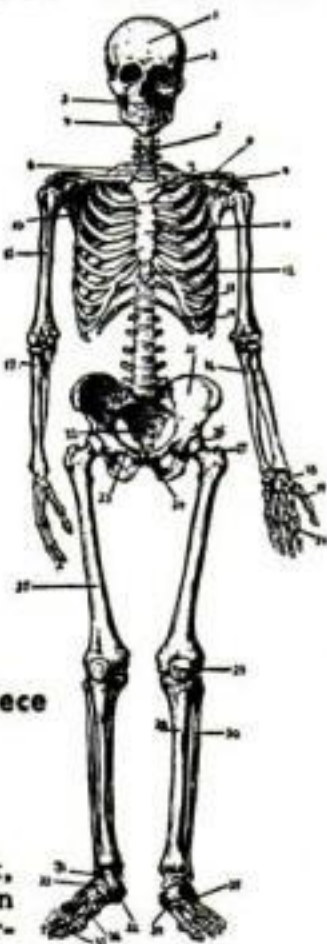
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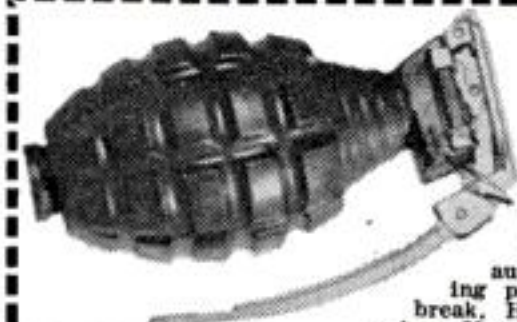
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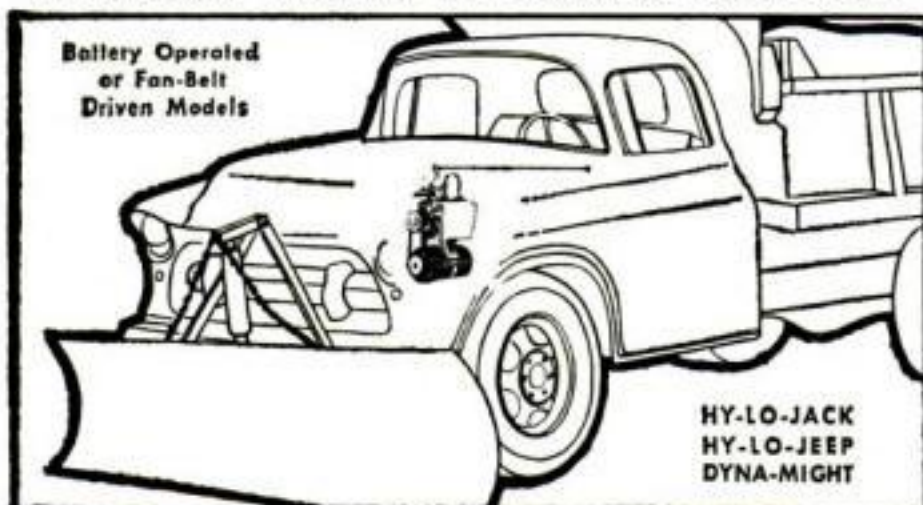
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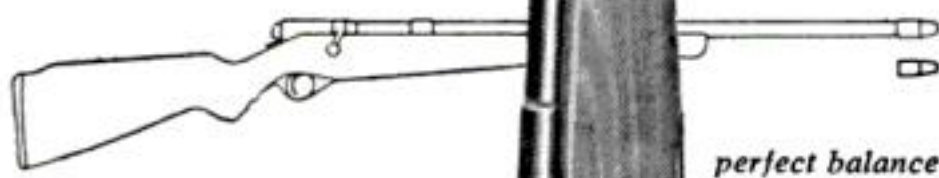
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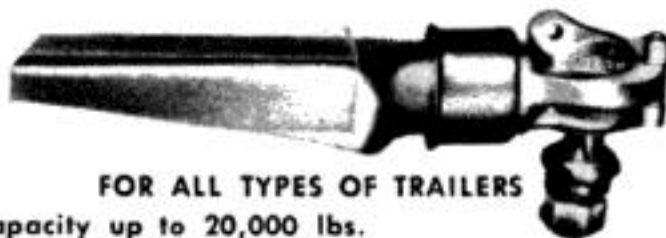
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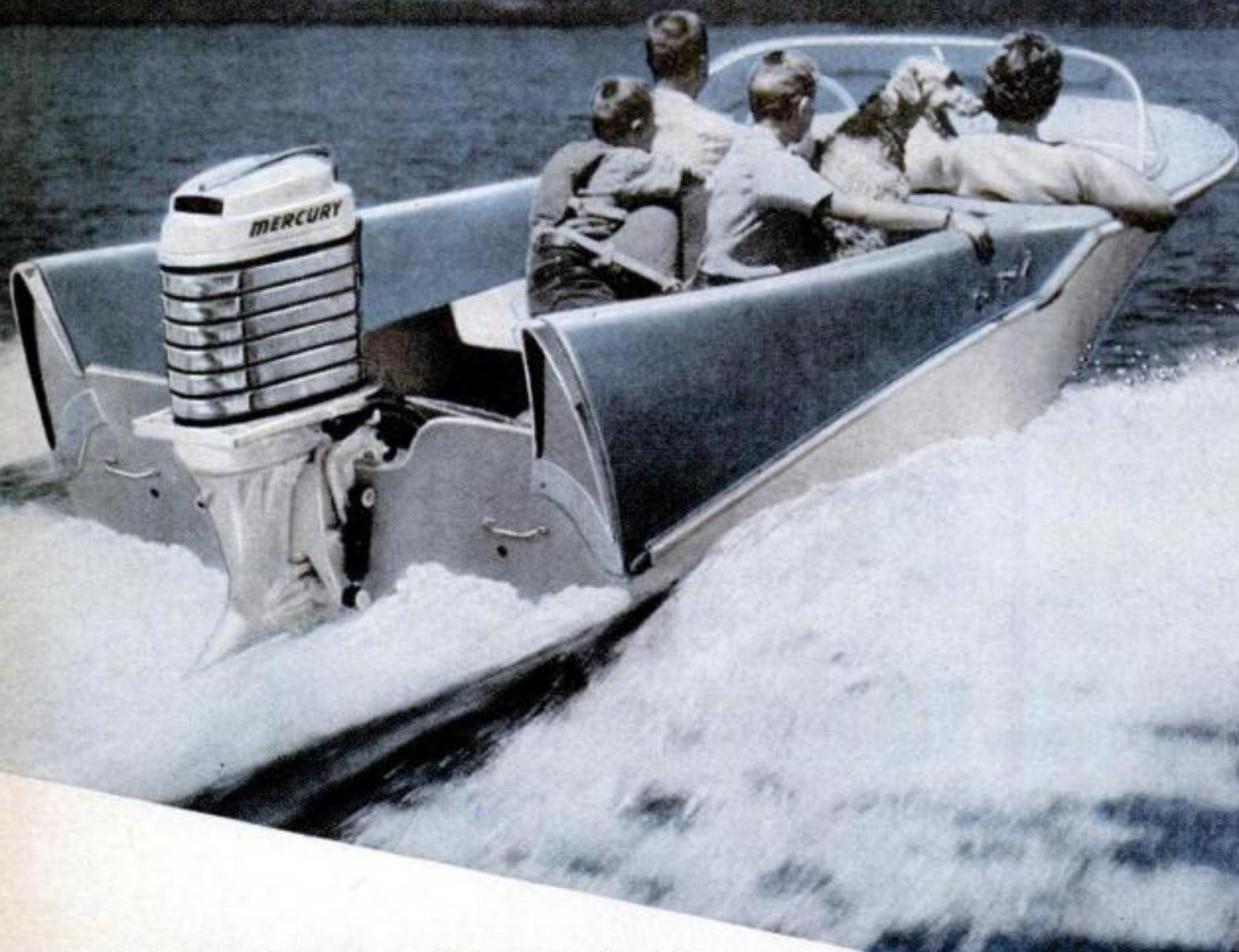


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THE General Motors Corp. opened the annual new-car season last month by putting three of its 1959 wares on display, and the wave of public astonishment could be felt all the way from San Francisco's Embarcadero to New York's Battery Park.

The three automobiles—Buick, Cadillac and Oldsmobile—were new from prow to stern. The Buick, in particular, was a pleasant shocker. The Cadillac was a departure from its conservative, grande-dame traditions. The Olds was as stunning as a Tahiti sunset.

Who said fins would disappear? Whoop-te-do! GM has seen the Chrysler Corp. in kings and queens and raised the ante in aces and deuces.

Size? All the cars—again—were longer, lower, wider and heavier.

Luxury? Croesus should blush in shame.

Options? Just ask, they've got it.

Prices? Higher.

But the significance in the design of the Buick, Cadillac and Oldsmobile—and, indeed, also in the Chevrolet and Pontiac, to be announced this month—was lost in the sea of gleaming metal. It was this:

GM is now prepared to make a complete change in styling in each of its cars *every year*. To make this possible, the corporation had to simplify its manufacturing processes.

GM now has two "common bodies." On one of these, the common parts are now interchangeable among two of the Buick lines, two of the Oldsmobile lines, one of the Cadillac lines and all the Pontiac and Chevrolet lines. On the other body, the common parts are interchangeable among the remaining Buick line, one of the Olds lines and two of the Cadillac lines. Common bodies, of course, mean less manufacturing expense.

They do *not* necessarily mean any of the same sheet metal, the skin that gives a car its ultimate configuration. It does not mean a sharing of such items as frames or engines. It *does* mean a sharing of some components in the actual body framework from the firewall back to the rear window.

The windshield cowl, for instance, is identical on all GM's 1959 cars. One model of a wrap-around rear window is identical for all five makes of automobiles.

Common body components are no novelty. Ford Motor uses them. So does the Chrysler Corp. So has GM. GM simply has carried the idea farther.

From a popularity standpoint, common body components and the resulting ease of making cars look brand-new from year to year make sense. Chevrolet, which had a brand-new body in 1958, ran away from Ford and Plymouth, which didn't. Oldsmobile, with an all-new body, clobbered Buick, without one.

For a look at the first of the 1959 GM crop of automobiles, see the following eight pages. For news of Rambler, see page 100; for the new Chrysler-built cars, see page 115.

First of the 1959 cars

GM Bets on Flaring Fins



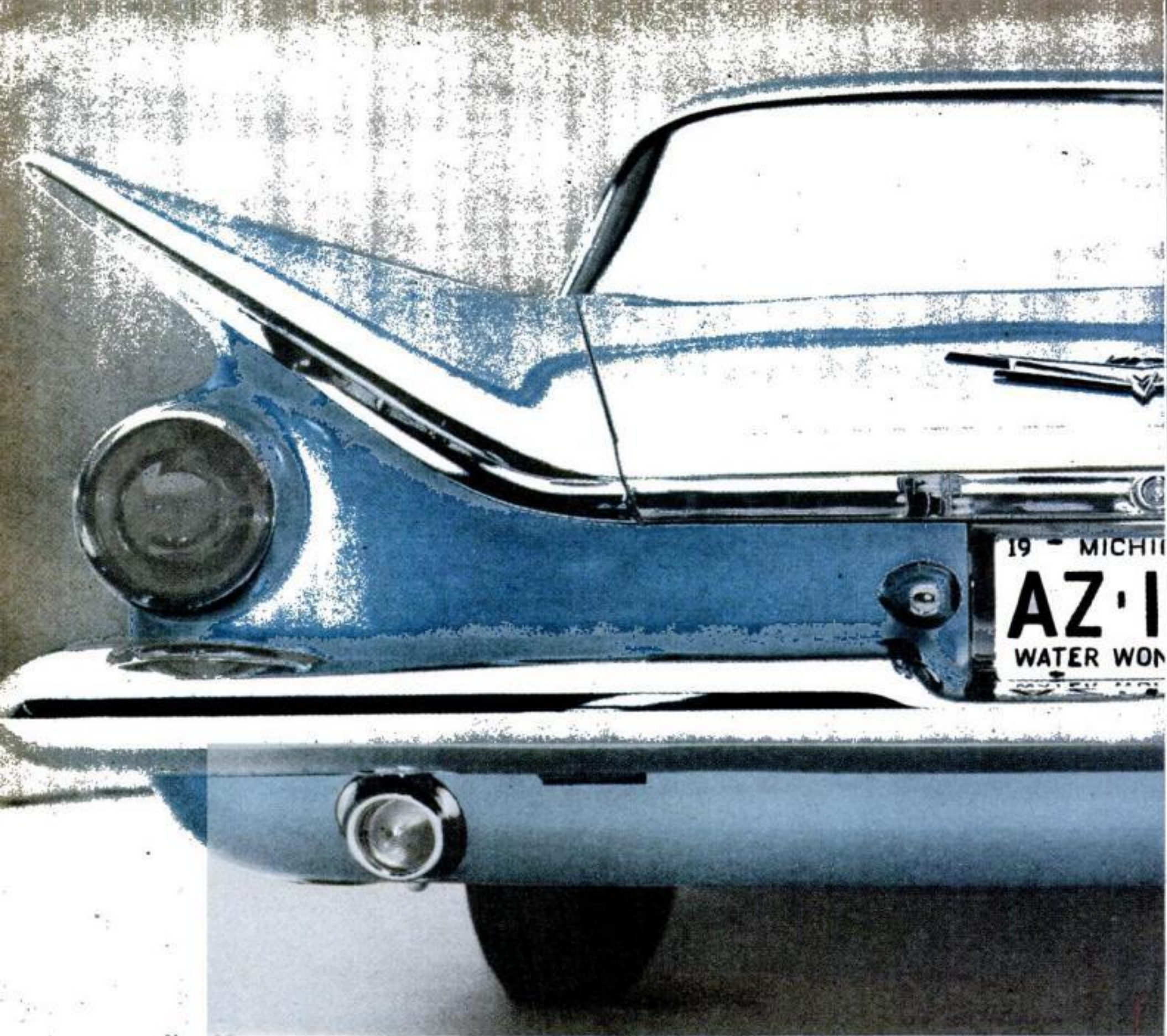
BUICK



CADILLAC



OLDSMOBILE



The '59 Buick:

You'd Never Know It Now

By Devon Francis

ONE day in 1947 Edward Tillotson Ragsdale, then Buick's chief body engineer, asked his wife Sarah why she never put down the top of the family convertible.

"The wind musses my hair," replied the practical Mrs. Ragsdale.

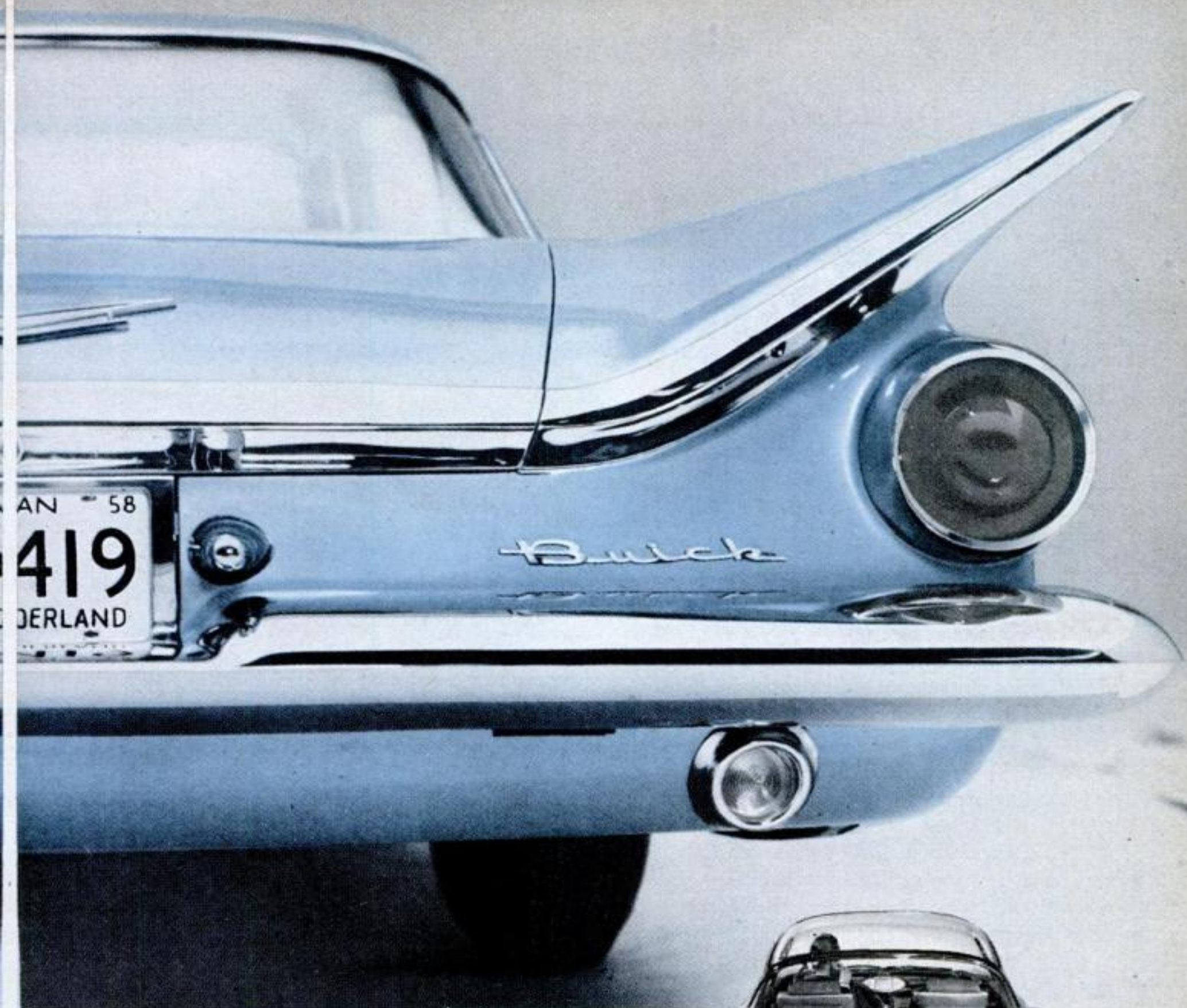
Her husband promptly put the key question to GM's styling center in Detroit.

"Why," he asked, "can't we build a sedan with open sides like a convertible?"

Rags is a pretty good freehand artist. He sketched. "Like this," he said.

He thus became the father of the hard-top "convertible," introduced by the Buick division in 1949 and now a common hardware item among all car manufacturers. The story is told here as a backdrop for the 1959 Buick. Rags is now a GM vice-president and general manager of the division.

The 1959 Buick began taking form late in 1956. The stylists had a lot of preconceived ideas on ornamentation—the

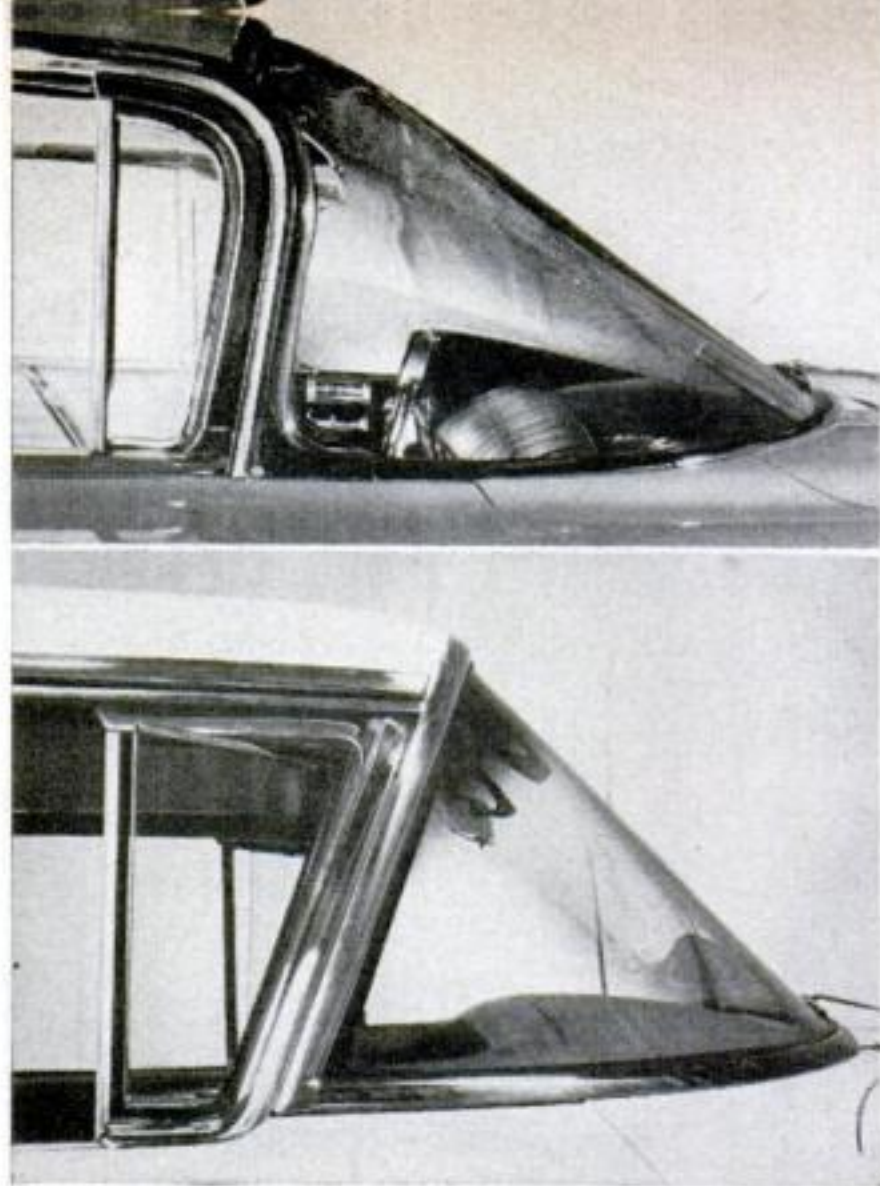


A WHOLLY NEW CAPSULE of sheet metal packages the new Buick (above and below), with winglike tail fins repeated in modified form above canted headlights. Rear-end treatment was inspired by Centurion "show car" (right) exhibited in 1956 GM Motorama. Buick is one to eight inches longer in most models and two inches wider, but only fractionally lower.





EVEN THE PANEL isn't recognizable as a Buick's. Triple-turbine Dynaflow, optional on all lines, has vertical selector quadrant. Twin-turbine drive is standard except on LeSabre.



WRAP-OVER OF NEW WINDSHIELD into roof is shown (top) compared with glass area in 1958, below it. Windshield is 27 inches deep vs. 18.5 last year, back window 29 inches vs. 18.

chrome geegaws known to the industry as "jewelry."

"Why," asked Ragsdale, annoyed, using some choice single-syllable words for emphasis, "can't we just start with a good-looking form for the car and use chrome only to accentuate the lines?"

At this point Harlow Curtice, GM's president, who had kept one eye cocked on Buick since he left its general managership in 1948, put in, "If we haven't got anywhere else to start, I've got an idea—one of the prettiest cars we've ever designed was the Centurion."

That was all that Rags needed. The Centurion had been a one-copy "show car" at the 1956 GM Motorama. But changes were necessary. The Centurion had a short wheelbase. That had to be lengthened. It had a rear end like the nose of a Cape Canaveral missile. That was altered to an ellipse, and finally fused completely into the deck lid and fins.

"Practically everybody we knew," comments Rags, sketching with his pencil, "was fiddling with those four-eyed headlights to look like this—

○ ○

or like this—

○
○

so we decided to place them like this—

○
○

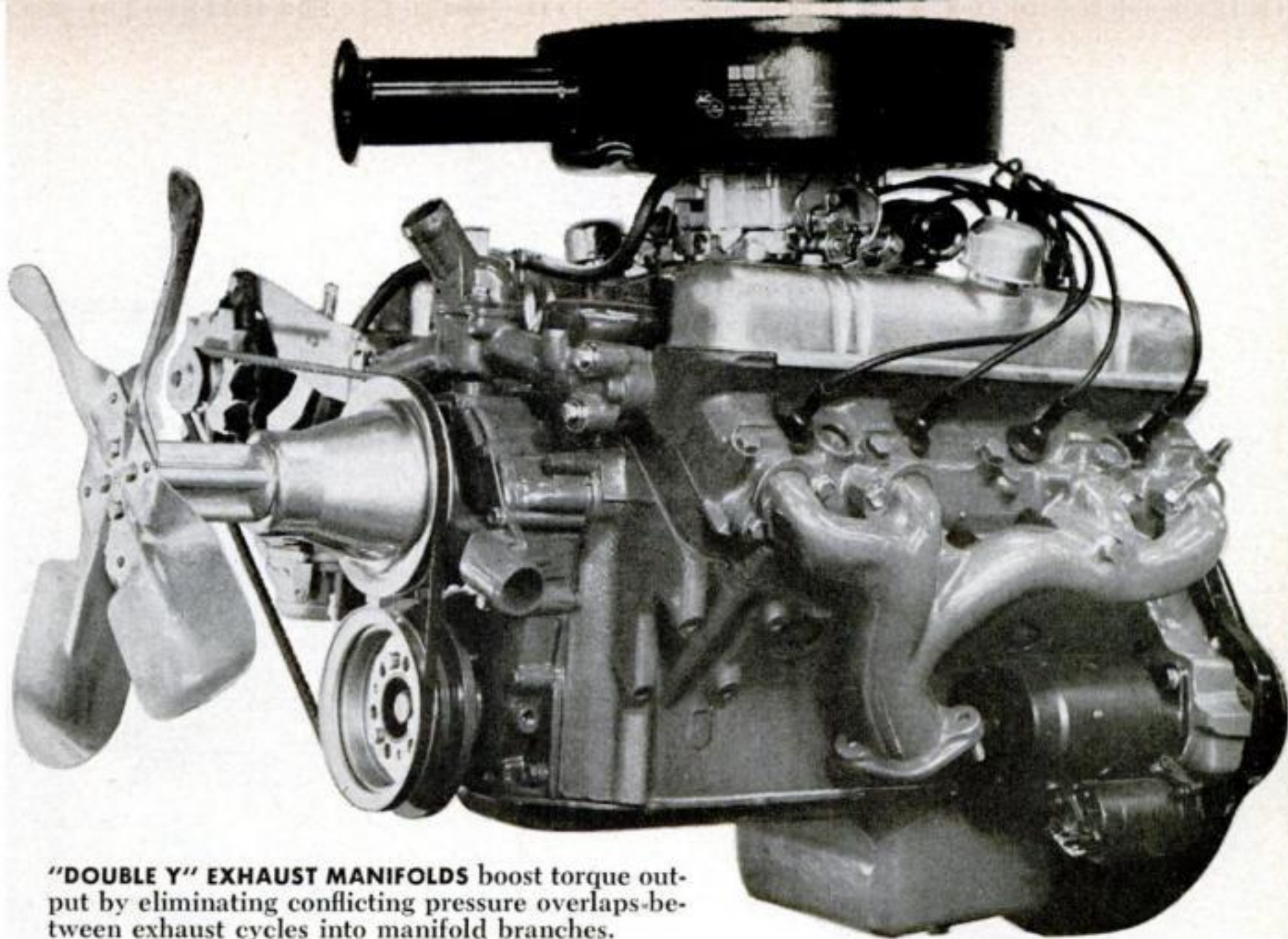
Over-all, we were shooting for a car that would have grace but spirit as well."

Buick's partisans, who are legion, probably will say they've got it—when they recover from their shock of a first gander.

Gone is that "Buick look" of almost a decade. Gone are those scimitars of chrome on the sides. Gone, even, are those treasured names—Roadmaster, Super, Century, etc.

Buick's break with the past is so complete that even the series designations are changed. LeSabre replaces the mundane Special, the Invicta the Century, the Electra the Roadmaster, the Electra 225 the long-deck Limited. ("All those old names," remarked one Buick engineer sourly, "sounded like railroad trains, and what's more passé than a train in a jet age?")

Probably not in all the latter-day history of the automobile has a car changed so radically in styling from one year to the next as has the Buick for '59. And that includes the new Chevrolet, to be announced this month. The Buick's tail fins can't be anything less than those of a brace of sailfish under hard right and left



"DOUBLE Y" EXHAUST MANIFOLDS boost torque output by eliminating conflicting pressure overlaps between exhaust cycles into manifold branches.

rudder. Amidships, these lines are absorbed in the body metal, but they burst out in renewed glory at the bow where they flatten to provide a *whoosh* look when viewed head on.

At first blush, it's not a matter of liking or not liking the car. Rather it's getting used to the idea that this collection of nuts and bolts and sheet metal, trained in squad drill, is really a Buick.

And ah, yes, the innards. Wheelbases and over-all lengths are increased. A K-frame replaces the old X-frame. There's a bigger engine. There's less slip in the automatic transmission. Air springing is offered only on the rear because that brings down the price and, frankly, air springs haven't been selling well. Heat-dissipating aluminum brake drums are standard in front on all the new Buicks.

That bigger engine is up 37 cubic inches to a total of 401 to power the Invicta and the Electras. LeSabre has to worry along with a little old 364-cubic-inch engine at an unchanged 250 horsepower. The horsepower of the bigger engine is 325 compared with 300 for 1958. But torque is up 45 notches to 445 pound-feet.

Engineers can do anything they please with horsepowers and torque, subject to what the company sales department wants

to advertise. They can raise or lower either, seesaw-like. For this seventh year with the same basic V-8—which started out at 322 cubic inches—Buick has decided to put most of its profit from the increased cubage into torque. There's more push when the light turns green and, with a new "economy" axle, it costs no more gas.

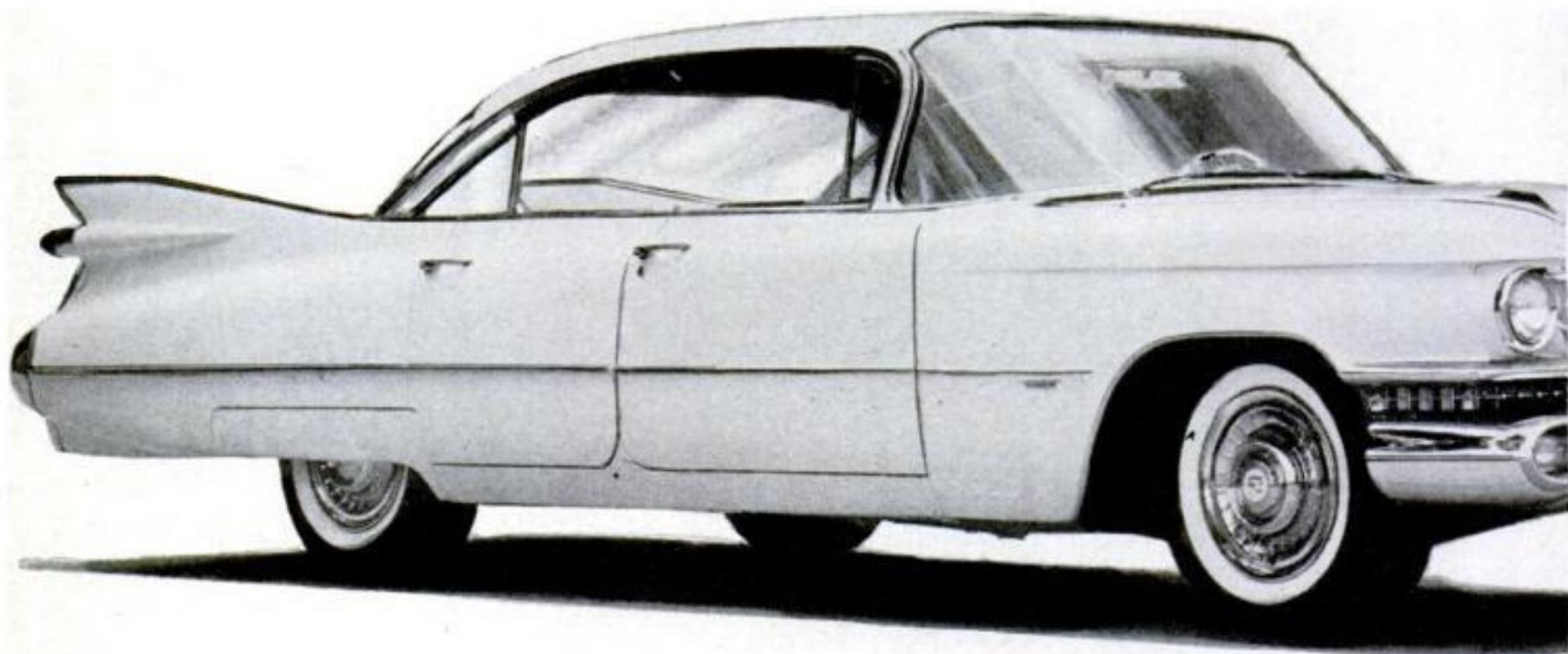
The gas-economy story on the new Buick is no great shakes, but by and large the car is more sparing of fuel.

Finally, Buick has coped with the motorist's old, old problem of maintaining a constant temperature in a car in winter. Most car heaters thermostatically control the "discharge air" coming into the passenger compartment by regulating the amount of hot water going through the heater core. But it takes constant fiddling with the temperature-control knob and blower speeds to accommodate the variables of passenger load, and in-car and outside temperatures.

For 1959 Buick (and Cadillac and Pontiac) has a three-element sensing system to create and maintain a comfortable heat level. It samples not only the discharge air but the in-car and outside temperatures, pools the information, and regulates the heat accordingly. **END**

The '59 Caddy:

Traditional Luxury in a Flamboyant Package



IF THE Cadillac motor car is, as it is advertised, "the standard of the world," then some extraordinary things are about to happen to the sterns of horseless carriages.

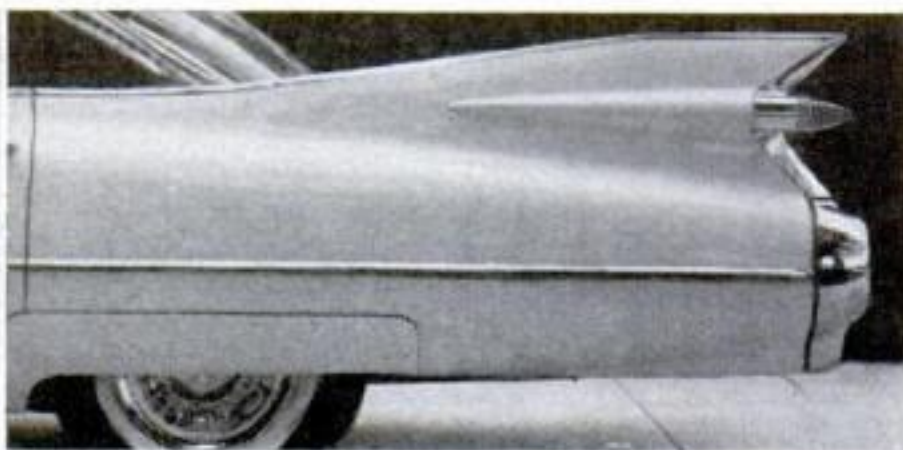
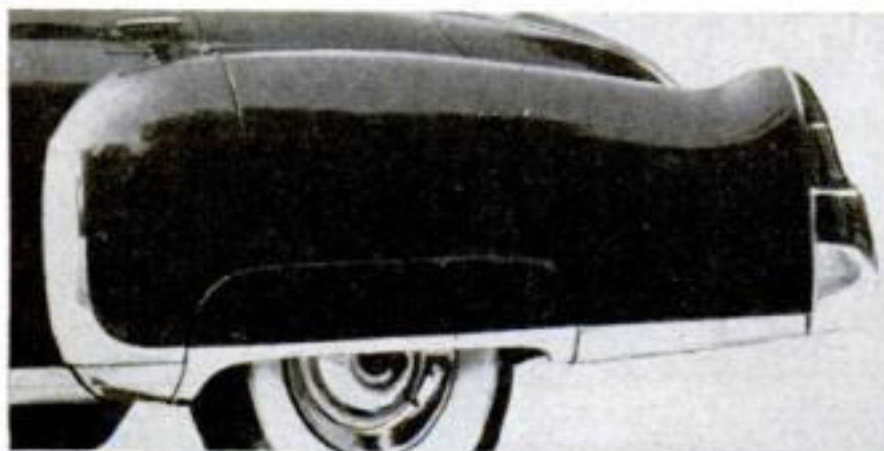
The 1959 Cadillac has tail fins that stand just two inches short of four feet off the ground. That's an increase of three and three-quarter inches from the 1958 edition. The new Caddy's fins are only 10 inches lower than its roof. They're two and a half inches higher than the fins of the 1959 Chrysler New Yorker, one of motordom's finniest vehicles.

The fins are a part of a completely new Cadillac package. The Caddy clung to

one basic body shell for five long years, moving a bit of chrome around and changing grilles year to year. All that's changed now. There's little in the old Cadillac that's recognizable in the new.

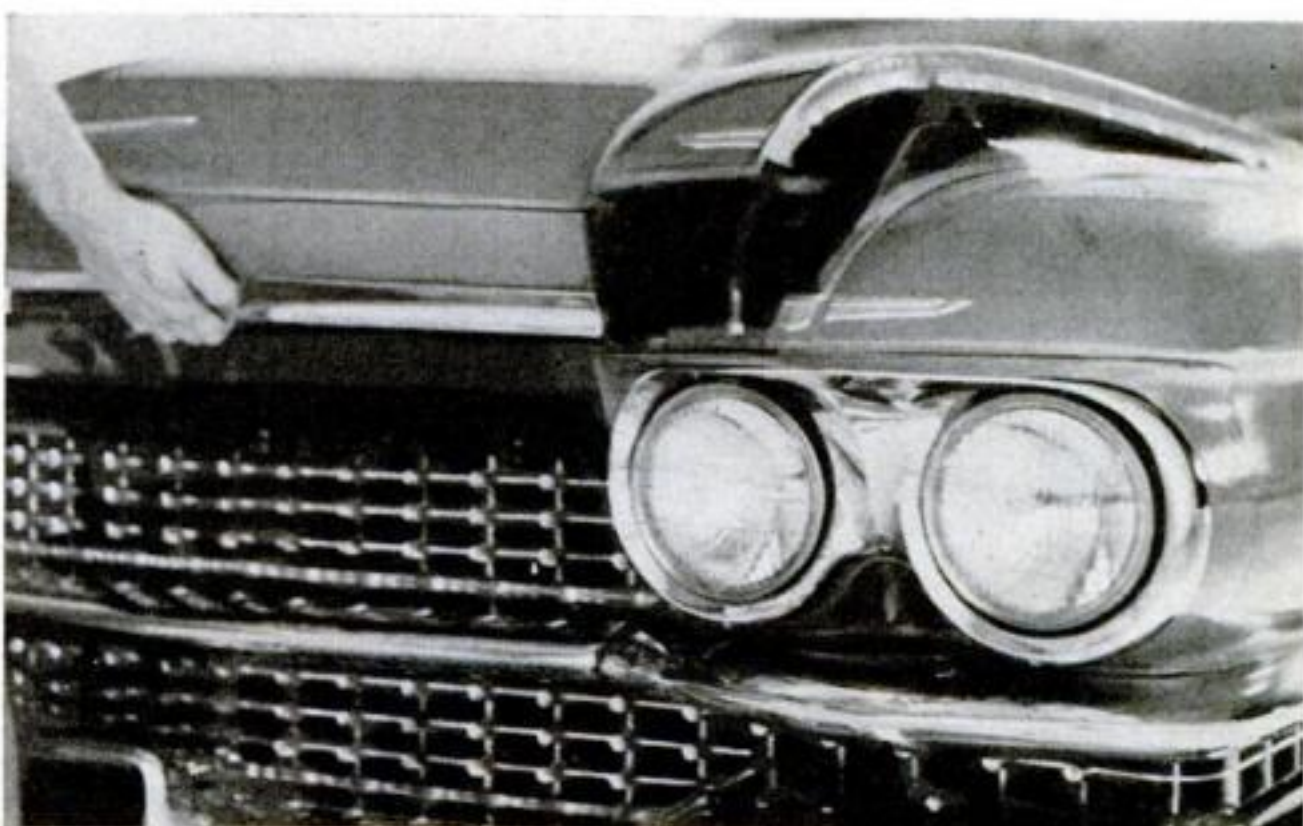
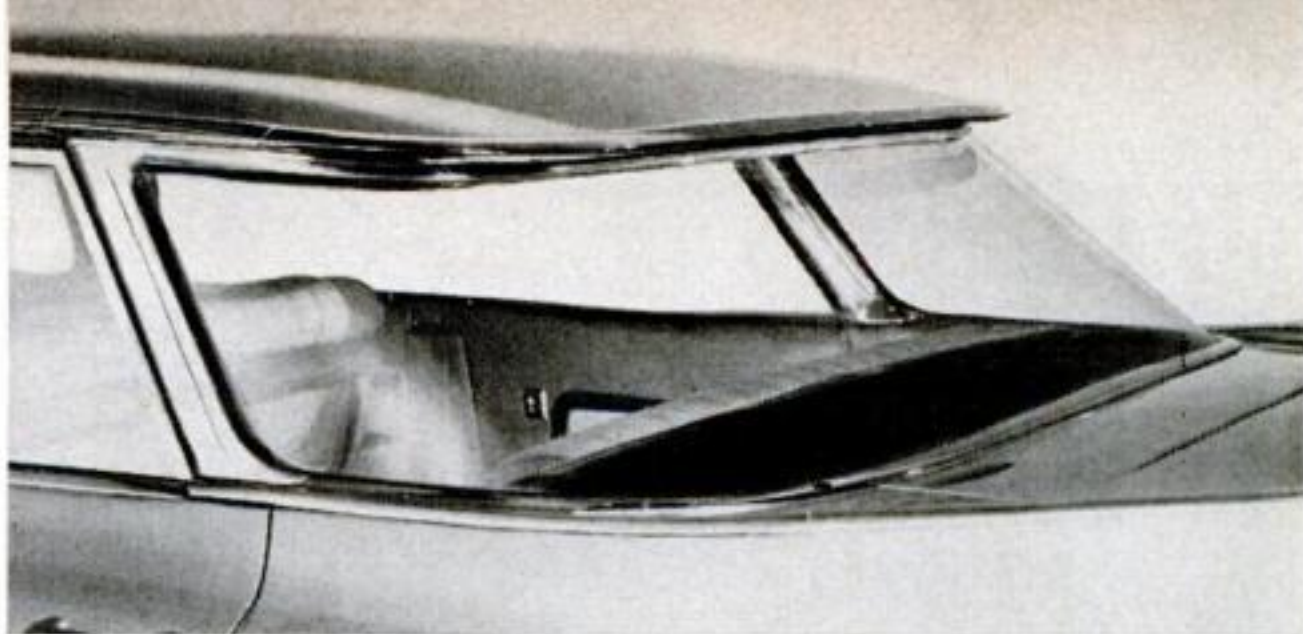
In common with other GM cars of the fresh vintage, the Caddy has that swept-back, pompadour windshield, but it's less pronounced than that, for instance, in the Oldsmobile. The Caddy also has a higher rear window—25 $\frac{3}{4}$ inches as compared with only 18 in 1958—but it's less pronounced than the Buick's which is two and a quarter inches deeper.

The height of the new Series 62 Sedan is only 56.2 inches, down almost three



Fins and how they grew: at left is 1948 Caddy, with industry's first fishtail, and 1959 version.

SNOOTY AS EVER, new Cadillac is thin-roofed (right), like all the '59 editions of GM cars. Rear window, resembling steamboat bridge, is available on standard sedan or plushier Sedan de Ville. Hood (below) cuts into fenders. Engine cubage is upped to 390 inches.



inches from 1958. The roofs of the Series 62 and Series 63 coupes are just a little over four and a half feet off the ground. Each of the new Cadillacs is a whopping 18 and three-quarters feet long. That's one and a half to eight inches longer than most of the various models measured in 1958.

And right about here all comparisons between the new Cadillac and the rest of the GM stable of new cars ends. From the 14 electric lights on the perimeter of its sheet metal—exclusive, mind you, of the license-plate lights—to a ride made softer by a few wisps of Freon gas in the shock absorbers, the Caddy remains in a class by itself. It's still a queen. Changes in the sheet metal somehow leave its hauteur untouched.

The car's ride probably is the most important mechanical change. Shock absorbers perform two functions. They make springs, in effect, bigger than they are by imposing restraints on their movements. They also snub-down the oscillation of springs from shock and rebound.

The theory is good, but the ordinary shock absorber used with today's soft

springs can't display the full range of its talents. That's because it contains air as well as oil. The oil flows up and down in a cylinder through orifices in a piston, or plunger, to cushion shock and rebound. It also flows out through a relief valve into a reservoir surrounding the cylinder. That's necessary because the rod of the plunger displaces the oil as it travels through the cylinder, and the oil has to escape if the cylinder isn't to burst from pressure. Air is permitted in the reservoir because the amount of its oil content varies with the position of the plunger.

Air and oil inevitably become a spongy mass. This sacrifices what engineers call its energy-absorption potential. The spongy mass excites the running gear of the car. The wheels dance on rough pavement, transmitting vibration.

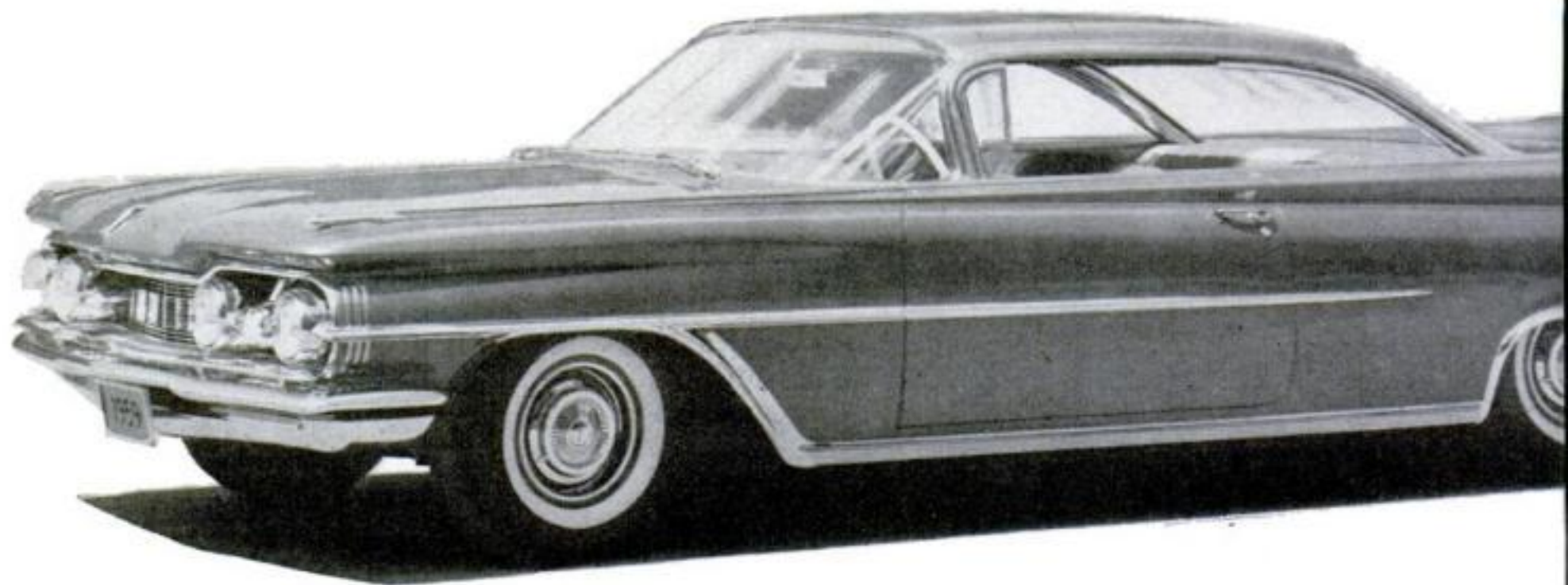
The only answer to all this has been to tighten up the orifices in the plunger, restricting the movement of the oil, thus holding a rein on the running gear—and hardening-up the car's ride.

Well, Cadillac solved that one. If air could be excluded from the shock ab-

[Continued on page 244]

The '59 Olds:

Chest-High and Lots of Glass



A FEW months ago, a couple of youngsters with a camera, leaning on the sill of an open window at the Oldsmobile experimental garage on Olds Avenue in Lansing, Mich., snapped a picture and took to their heels. A block away alert factory cops nabbed them and demanded the film.

The kids had a nose for news. They almost got a photographic preview of a car that ought to make history during the 1959 model year.

The new Olds is one of two candidates named by an army of beauty experts for the title of the handsomest automobile in Detroit's entire new crop. The other one is the forthcoming Pontiac.

Just what makes these cars so toothsome isn't hard to tell. Over-all, it's the basic configuration of the sheet metal. A judicious and sparing use has been made of chrome. Neither car departs strongly from the industry's current concept of what an automobile should look like.

Both cars are distinctive without caricaturing such furbelows as tail fins. And the Olds probably has achieved the most satisfactory solution to date of what to do with those four bleak-eyed headlamps that, on most cars, look as severe as a school teacher who has just caught her prize pupil cribbing an examination.

At 56 inches, the car is an inch lower in most models, two inches wider and

(alas!) from five and a half to 10 inches longer.

If the U. S. motorist has a quarrel with General Motors on its 1959 cars, it can well be on the score of length. On a wheelbase that's just about the same as 1958's, the Olds overhangs are up to almost three inches longer in front (36.4) and seven in the rear (60.3). In parking operations, it will be a help if Junior stands on the curb yelling directions.

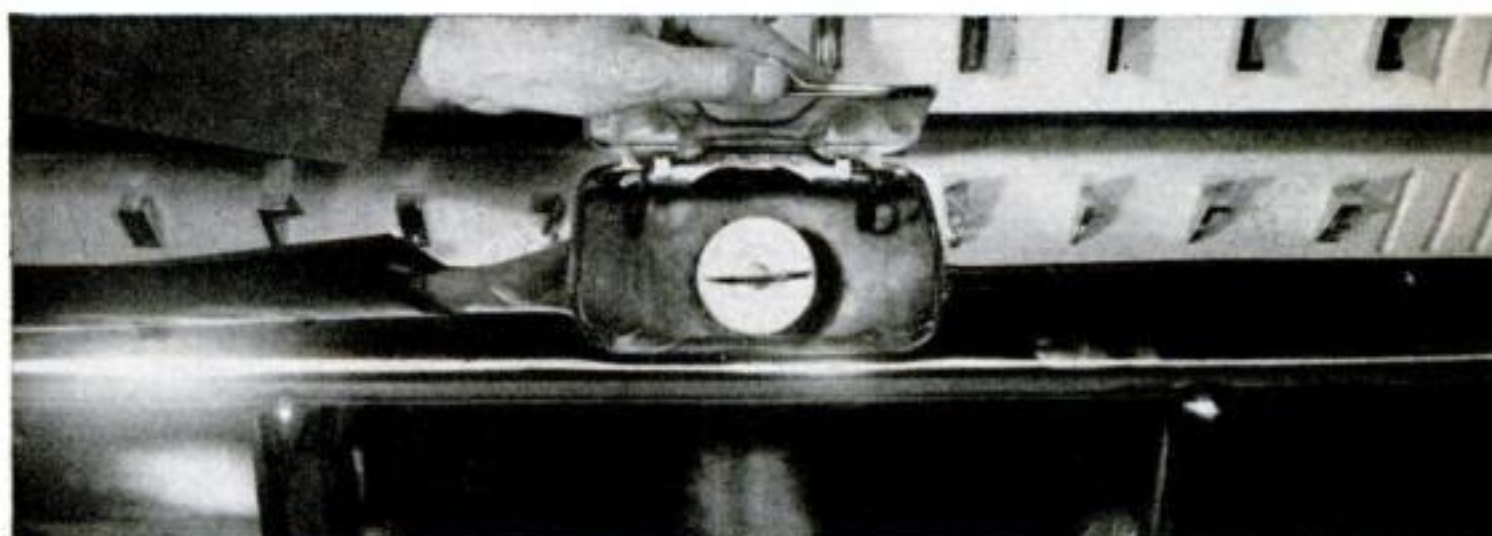
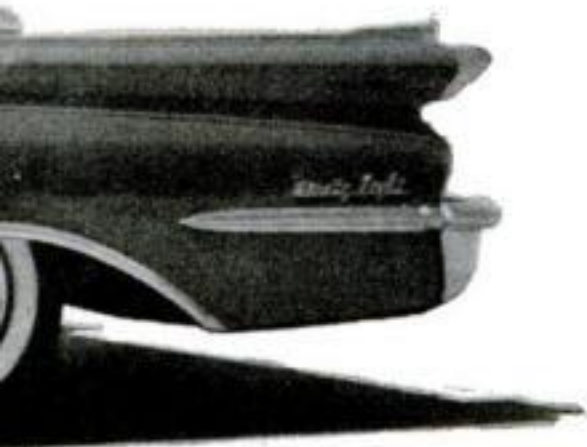
The 56-inch-high cars aren't the lowest. The Olds Holiday Sedan, a number with that steamboat-bridge rear window like the Cadillac's, stands just a fraction over four feet, six inches above the pavement.

The glass area is so huge in the windshield and in the more conventional back window (vaguely resembling a fighter-plane canopy) that, with a foreshortened roof, heat-reflecting, tinted glass is a must both fore and aft. Sun visors are, of course, standard in front but also are optional in the rear, and a good thing they probably are, too.

Oldsmobile's treatment of the top of its rear fenders—if fenders they can be called, and whatever happened to yesteryear's plain old mudguards?—is unique in the industry.

"They're *not* fins, back there," said an Oldsmobile stylist with an obvious touch of embarrassment. (And, indeed, they're

WIDE-SPACING, with turn signals between, is Olds' solution to problem of prettying-up four-eyed head-lamps (right). As in Caddy, hood laps over into fender area. Gas filler door (below) is in center of rear bumper.



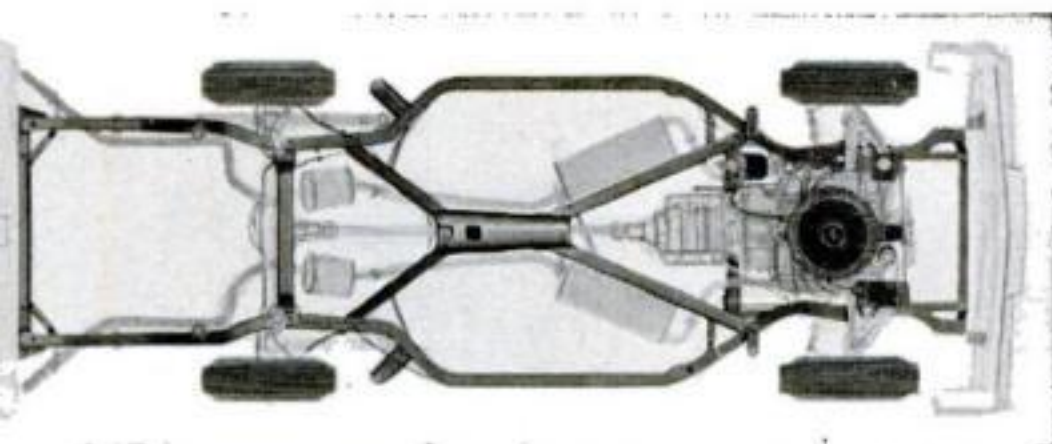
not.) "We didn't know," he went on, "quite what to call them, so we settled for 'booms.'"

Mechanically and structurally, the car has had a thorough updating. Even the engineers, who always find something to grouse about, are almost pleased. The first company to have the courage, last year, to *reduce* horsepower, Olds yielded for 1959 to temptation, and increased its

engine size for the Super 88 and 98 series. The 88's cubage remains at 371, but that for the other two lines is up from 371 to 394. The respective horsepowers: 270 and 315.

Along with several other high-compression engine manufacturers, including Cadillac, Olds had to reduce compression ratios at the dealerships in some parts of

[\[Continued on page 246\]](#)



A WIDENED FRAME carries no outrigger brackets—it fastens directly to body. Rear step-down on lowered floor is 2.6 inches greater.

REAR-WINDOW WRAP-OVER into car roof makes sun protectors (below) a welcome accessory.



CLEAN PANEL contains a new-type speedometer that glows green at speeds up to 35 m.p.h., orange up to 65, a warning red thereafter.

Same window viewed from above shows how rear-seat passengers can look directly up.



Accident at Windscale:

World's First Atomic Alarm

By Hartley Howe

Just a year ago there occurred at the Windscale plutonium factory in England the world's first nuclear accident to reach beyond an atomic site's fence and into the everyday lives of people outside.

The well-investigated case history of Windscale's accident now offers one illuminating example to help in picturing what might happen anywhere if an A-plant ran amok. A recent visit to the scene by a POPULAR SCIENCE reporter yields this account.

I

THE man on the receiving end of the phone call was Harold Macmillan, Great Britain's Prime Minister, and he was hearing alarming news. Pile No. 1, one of the pair of great plutonium-

making atomic reactors at the Windscale plant in northwestern England, was afire. Radioactive fallout, spewing from the 400-foot-high exhaust stack of its air-cooling system, was settling on neighboring communities. Civil Defense forces might have to be called out to deal with a disaster. It might become necessary to evacuate everyone in the southern part of Cumberland, a county of 1,500 square miles and some 250,000 inhabitants.

That was late on Thursday, October 10, 1957. Soon after midnight another phone call alerted the Chief Constable of Cumberland to be ready if a mass evacuation should be ordered.

News of the atomic emergency was withheld from the public—to avoid “unnecessary alarm,” a later report said.

It leaked out the following morning, Friday the 11th, when a housewife heard from her grocer that atomic-plant workers

While the public slept, A-men checked fallout settling



FALLOUT SPEWING from top of stack of Pile No. 1's air-cooling system contaminated 200-square-mile area. Radioactive cloud was detected as far away as London and Denmark.



GAMMA-RAY PATROLS gauged radioactivity from fallout on ground. Highest reading, at Selafield station, was hundreds of times normal background, but showed no immediate danger.



DONNING GHOSTLIKE GARB as above, for protection from escaping radioactivity, crewmen

sought its source in Windscale pile—and made the startling discovery that the pile was afire.

on the countryside. False alarms followed—then real ones

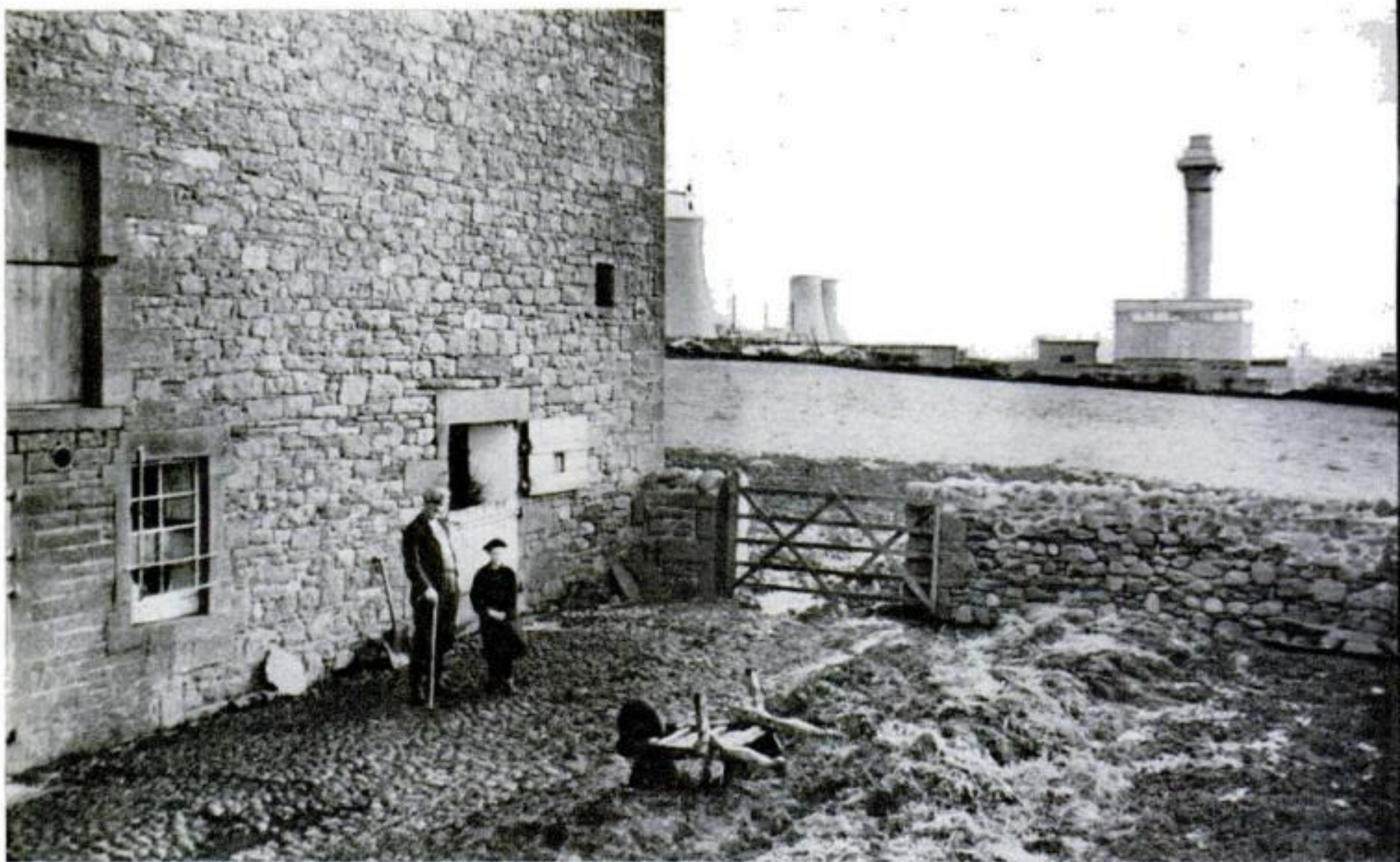


FINDING CLOTHES of cyclists were radioactive was one of series of scares when news of crisis first leaked out. Public wasn't told the radioactivity had been found harmless.



MILK WAS DUMPED down drains into sea, when its contamination by fallout proved a real hazard. Radioiodine, which it contained, had settled on the grass that the cows ate.

The scene of an atomic accident—from the point of



W. E. HEWITSON (with cane), a stocky ruddy-faced dairy farmer of the hamlet of Yottenfews, typifies dwellers near Windscale plant in background. Milk from his cows, as from others,

was seized and dumped after accident. He and a neighbor who raises pedigreed bulls say customers fear radioactivity has impaired cattle's fertility, though A-experts deny it.

had been sent home "because one of the Windscale piles is on fire." She told her husband, a newspaper editor in nearby Whitehaven. He told the Associated Press and the British Broadcasting Corporation. Reporters swarmed to the scene. This looked like the Great Atomic Disaster that so many had warned about. The unknown was about to happen.

The grass was radioactive at Seascale, someone with a Geiger counter quickly discovered. To the dismay of two cyclists, who had pedaled to work that morning along the railway track from Seascale, their clothing proved to be radioactive too. Windscale's A-men knew, but the public didn't, that the grass and the clothes weren't "hot" enough with body-penetrating radiation to bother anyone.

It was a day of anxiety and suspense for the region's inhabitants.

Saturday the 12th brought rapid and conflicting developments.

"I Slept in Death Village," proclaimed the headline of one reporter's tale.

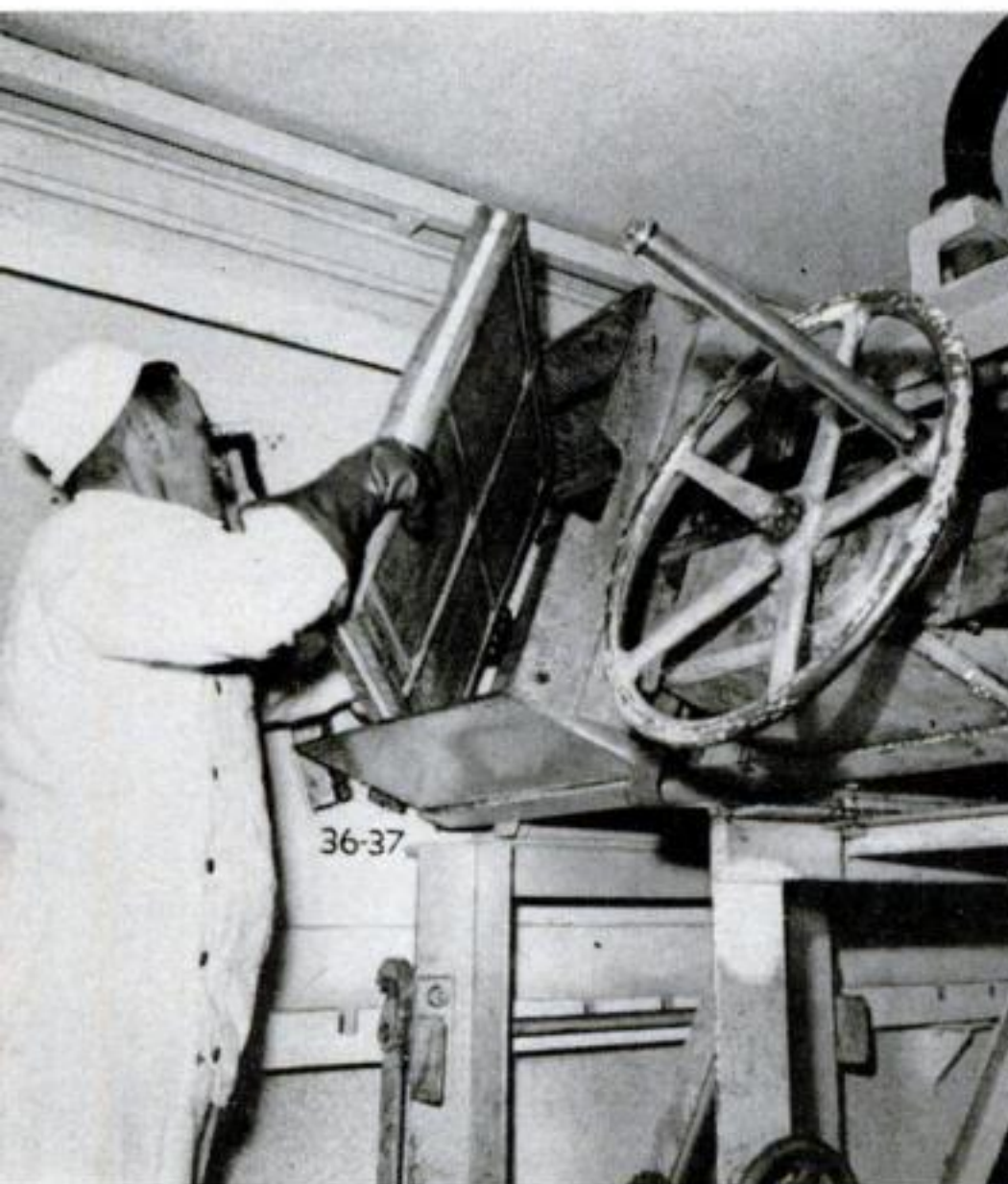
The fire in the big pile was extinguished at last, and the Atomic Energy Authority in London belatedly issued a reassuring public statement on the accident. Almost at the same moment, the first sign of real danger appeared.

Milk from neighboring farms, only just analyzed, showed more than a safe amount of radioactivity. Sleepy-eyed farmers were awakened to learn this, late Saturday night, when policemen knocked on their doors and warned them not to use the milk from their cows.

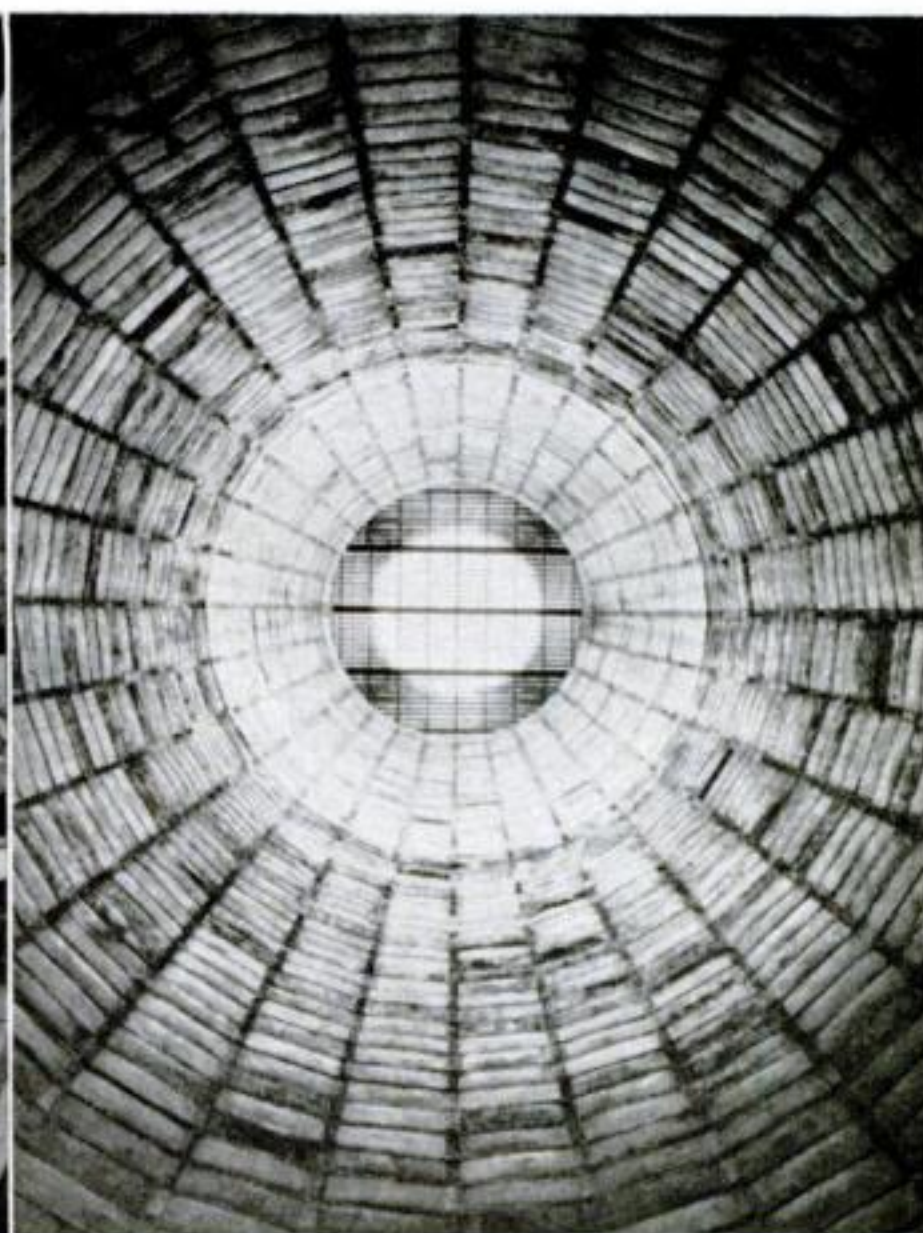
Deliveries of milk from the 12 dairy farms within a two-mile radius of Windscale were banned. Glumly the farmers handed over their condemned milk and watched it poured down drains into the Irish Sea. They brightened when they were told they'd be paid for it.

Soon the area of the ban was extended. By Monday the 14th, all milk was being dumped into the sea from a 30-mile-long coastal area, six to 10 miles wide. Its inhabitants were drinking milk brought in

view of Windscale's neighbors, and of men in plant



FILTERS like the one held here, in gallery atop pile's air stack, could trap radioactive dust—but couldn't prevent wisps of radioiodine's purple vapor from escaping freely.



"INSIDEST" VIEW looks up air stack along route taken by escaping fallout, toward filter gallery that didn't stop it—as first indicated by its descent on an adjacent building.

from other parts of the country. Local farm crops, tested for contamination, were given a clean bill of health.

The radioactivity of grass in the cows' pastures, which had been imparted to milk when the cows ate the grass, was short-lived. Virtually all of it consisted of iodine 131, a radioisotope with a half life of only eight days—compared to the 28-year half life of strontium 90, the principal hazard of fallout from nuclear bombs. So the contamination in the Windscale region soon died down. Within a little more than two weeks, the ban on milk was lifted in half of the affected area; before long, in all of it.

The trail of Windscale's radioactive cloud, borne southeast on a 10-knot wind, led afar. As it passed over 250-mile-distant London, readings of radioactivity jumped to 20 times normal. It was detected as far away as Denmark.

But no one was killed, injured, or made homeless by the accident. The only chance of harm from the radioactivity,

said health experts, would have been from drinking the local milk for the brief time before it was banned—and calculations quickly convinced them that the maximum exposure possible in this way could not have been serious.

That was the story of the Windscale accident as the public saw it.

II

What had been happening meanwhile within the stricken plutonium plant was revealed later, when the inside story came out in an official investigation:

The fire's underlying cause was the strange behavior of the pile's graphite.

Windscale's Pile No. 1 consisted of a 50-foot-high, 25-foot-thick stack of graphite bricks, pierced by horizontal fuel channels. As in all powerful piles, the neutron-bombarded graphite absorbed energy, and stored it up. If nothing was done about it, a time would come when a most singular

[Continued on page 238]



From the labs...

A Reversing Hot-and-Cold Machine

Tiny crystals that heat or cool at the flick of a switch bring radical new appliances. First is a small '59 refrigerator

NEXT summer you will be able to buy the first of a new breed of home machine, an electronic marvel that makes today's appliances look like contraptions from the village smithy. It will be a small refrigerator. But it could as well be an oven, a blanket, an air conditioner, a heater, a salad bowl or a whole flock of other gadgets that haven't been dreamed up yet. It will open a new era of easier living (besides coming in mighty handy for a host of factory and laboratory jobs).

What it is is a hot-cold machine. Run electricity through it and it makes heat on one side, cold on the other side. Reverse the electricity, and the hot-cold machine reverses, too: The hot side makes cold and the cold side makes heat.

This device is a second cousin to the transistor. Scientists call it a semiconductor thermoelement.

It gets better and better the closer you look at it:

- There are no moving parts, just crystals soldered to wires. It makes no noise, and it doesn't wear out.

- It can be any size. A unit $\frac{1}{2}$ by $1\frac{1}{4}$ inches to cool the *inside* of a vacuum tube has been built; so has a wall-size panel to cool or warm a room.

- It saves on electricity. As a heater it is much more efficient than a regular resistance heater. As a cooler, it is already more efficient than small refrigerators, and will compete with larger and larger

refrigerators as development progresses.

- It should be reasonable to mass-produce—probably cheaper than transistors.

Westinghouse is already tempting the public with two classy thermoelement appliances—strictly to look at, not to buy.

One is a streamlined "hostess cart" that has a two-cubic-foot refrigerator on the cold side, a warming oven on the hot side. It carries its own batteries so that it can work at the barbecue pit.

The other: a gimmick for baby's bottle. About the size of a table radio, it keeps the milk cool until 20 minutes before feeding time, then switches over to heating, warms the milk to exactly 100 degrees, and buzzes a buzzer (softly) at feeding time. If baby sleeps through, that night, it automatically switches back to cooling.

Westinghouse won't commit itself to producing either of these two in its present form. It does promise "something like them"—presumably a midget refrigerator—in the showrooms and waiting for customers in 1959. It won't be cheap—estimated price of a baby-bottle warmer is \$50.

That's only the beginning. All the other appliance manufacturers—individually or through a cooperative research program at the Franklin Institute of Philadelphia—are in the act, too, pushing their lab men to come up with something to sell.

Refrigerators look like the best bet. Sales managers are alternately horrified and delighted to realize that most American homes, amply outfitted with electrical heating devices (toasters, percolators, blankets, etc.), have only one refrigerator, plus maybe a freezer and an

.....

FROST-COVERED CRYSTALS (black cylinders) reverse to heat when Westinghouse project engineer Bill Evans flips switch. Batteries of crystals go into new appliance ready next year.

air conditioner. The reason the cooling market is so far from saturated is that there hasn't been anything to saturate it with. You can't squeeze standard cooling machinery—motor, compressor and coils—into small appliances.

Take the kitchen refrigerator. With the small semiconductor thermoelements, you can break the refrigerator up, the way the electric stove has already been subdivided into independent units (electric skillet, pot, coffee-maker, oven rotisserie). It would be more convenient for your wife (and more profitable for appliance manufacturers) if she had a cold shelf for bottles near her glassware, plus separate cold drawers for vegetables near the sink and meats near the stove.

And there are a lot of other things waiting to be made with the new semiconductor cooling units. For instance:

- An electric ice-water pitcher.
- An electric cold pad (flip the switch and it's a heating pad).
- An electric blanket that keeps you cool in summer as well as warm in winter.
- Bowls and plates that keep appetizer, salad and dessert cold, soup and main course hot.
- Small cold boxes for ice cubes and drinks in strategic locations: bar, bedroom, nursery, car.

Why did it take so long? A Parisian watchmaker named Jean Charles Athanase Peltier discovered the heating-cooling effect of electricity 124 years ago. This got his name into every physics textbook printed since. But that's all. The practical uses, up until now, have been zero.

The reason was that the heating-cooling was too little to be useful. At best, the cold side could be kept only a degree or two cooler than the hot side.

The Peltier effect shows up when electricity crosses the joint between two different materials. The electrons, which make up an electrical current, possess more energy in some materials than in others. When they move from a low-energy material to a high-energy one, they have to gain the energy difference. This they do by extracting heat from the materials themselves—cooling the joint. The electrons carry the heat energy away from the joint to the opposite ends of the two materials, releasing it there (You have to use direct current; with AC the heating-cooling would alternate and you'd end up

with nothing. Appliances would have built-in AC-to-DC converters.)

For a long time the only materials to work with were metals. The energy difference between metals is not great. Worse yet, metals conduct heat as well as electricity, so the hot ends warm up the cold joint.

The breakthrough came in the 1930's when physicists began using quantum mechanics to poke around in unfamiliar materials called semiconductors. The name is accurately descriptive: Semiconductors pass electricity too easily to be insulators, but not easily enough to be conductors.

This investigation uncovered some very intriguing goings-on. First off, semiconductors don't transmit heat very well.

Better still, it turns out that you can reduce their heat transmission without harming their electrical conductivity. The trick is to "dope" very pure crystals with precise amounts of impurities. The impurities break up the even crystal pattern and block the passage of crystal vibrations, which is one way heat is transmitted.

And more: Doping also controls electron energy, which determines the amount of cold (or heat) produced. You can take the same semiconductor compound, dope it one way to give its electrons high energy, dope it another way to give its electrons low energy.

So it settles down to a hunt for the right semiconductors, ones that:

- Carry electricity easily.
- Carry heat poorly.
- Cause a big energy change (release or absorb much heat) when electricity crosses their connection.

In Russia, A. F. Ioffe and his assistants started hunting in 1929. In the U. S., pioneer work began a little later at RCA under Nils E. Lindenblad and at Westinghouse under Maria Telkes. It is beginning to pay off now.

The results. Both the Russians and Americans are willing to talk about thermoelements that can cool by 125 degrees—ample for a refrigerator. These are made of bismuth telluride or selenium telluride. Presumably there are better ones they won't talk about.

The Russians have built experimental refrigerators, including some for the Tu-104 jet airliner, and have actually pro-

**What they can make with
new hot-cold crystals**



BLANKET will keep you warm in winter, cool in summer.



DRAWER REFRIGERATOR will keep ice handy in your desk.



HOSTESS CART will take refrigerator, oven to patio.



PITCHER FOR CAR can keep coffee hot, water cold.



CRYSTAL-LINED WALLS will cool closet to foil moths.



BOTTLEHOLDER will chill baby's milk; warm it, too.

duced fairly large quantities of scientific instruments (notably microtomes) that employ semiconductor cooling.

RCA showed off a refrigerator and an air conditioner, both experimental, two years ago. Other firms have built similar ones. But only Westinghouse has reached the make-it-and-sell-it stage. Westinghouse evidently has a new material that is very efficient and easy to mass-produce.

What next? Heavy cooling-heating jobs are still uneconomical, even with Westinghouse's semiconductors. The hostess cart cold box does not make ice cubes, and the warming oven gets an assist from resistance heaters. So there's still a ways to go before you'll get an electronic freezer or household-size refrigerator, let alone wall panels to heat and cool your house.

Such things are definitely in the cards, however. And the farther future promises even more.

Semiconductors can also generate electricity, for instance. If you heat the hot side and cool the cold side, current flows (see "New Ways to Generate Electricity," PS, Aug.). Another kind of semiconductor pumps juice when light shines on it.

This has already led to products—portable radios and hearing aids—that use semiconductors both as electricity-makers

(solar cells) and as electricity-users (transistors). More such neat, all-in-one-package devices are in sight. They mean radical changes in the way you'll live in the not-so-distant future.

A semiconductor generator might replace the dynamo on your car, making electricity from the waste heat of the engine. Besides taking care of ignition, the power could feed heating-cooling semiconductors at the seats.

Eventually, central heating and cooling for house or car might be unnecessary. No furnace for the house, no heater for the car. No heavy overcoat for winter, lightweight suit for summer.

A walking power plant. One type of suit would do the whole job. Make solar cells into buttons or a braid along your shoulder. Put a thermostat in your breast pocket to control the power. And line the suit with a semiconductor-coated cloth (like Milium aluminum lining) to convert the electricity into heat or cold, as the weather demanded.

You'd carry your own combination furnace-air conditioner—literally on your back!

No, it won't work in the dark. But then you could snuggle under your hot-cold blanket.—*Martin Mann.*



New features include two-piece die-cast grille and greater swept area for windshield wipers.

1959 Rambler Boosts Its Miles Per Gallon



INDIVIDUALLY ADJUSTABLE FRONT SEATS are a fresh feature. Optional headrests come singly or in pairs, position at 10 different angles, and remove by lifting from the sockets.

WHEN the American Motors Corp. closed its book on the 1958 Rambler and unveiled its 1959 models late last month, it had gathered a good idea about a couple of things that the U. S. public wants in a smaller-than-average car.

The public wants more miles-per-gallon—the six-cylinder Rambler outsold the V-8 Rambler by more than nine to one. But a fair spate of the public still wants its driving ease—half the Ramblers sold had fuel-consuming automatic transmissions.

So, for 1959, the engineers have improved the controls on the automatic drive, and at the same time have boosted gas mileage with some lower axle ratios for both engines and a more economical carburetor on the six.

Most of the changes in the Rambler are minor and for a good reason. This automobile, by the standards of previous

years, is still selling like corn at a clam-bake. American Motors sold 119,000 of them during the 1958 model year—when all other U. S. cars were down in volume. That compares with 62,700 only two years ago and 82,000 in 1957. The latest sales figures cover only the 108-inch-wheelbase Rambler. It doesn't include the smaller Rambler American or the bigger Ambassador.

The engine-starter button on the '59s is combined with the neutral button on the panel-mounted automatic transmission control console, eliminating ignition-key start. A vacuum lockout prevents starter engagement when the engine is running. Console lighting varies with the function of the particular button—amber for neutral-start, red for reverse, and green for low gear and the two drive ranges.

The overdrive axle ratio on the six is down from 4.38 to 4.11:1, and that for the V-8 with automatic drive from 3.55 to 3.15:1.

A new grille is made in two pieces to cut repair costs if it's damaged. Both front and rear bumpers are heavier. Mufflers are aluminum-coated inside and zinc-coated outside to discourage rust. Brake linings are thicker, and on V-8 models the front primary shoes have been widened from 2 inches to 2½.

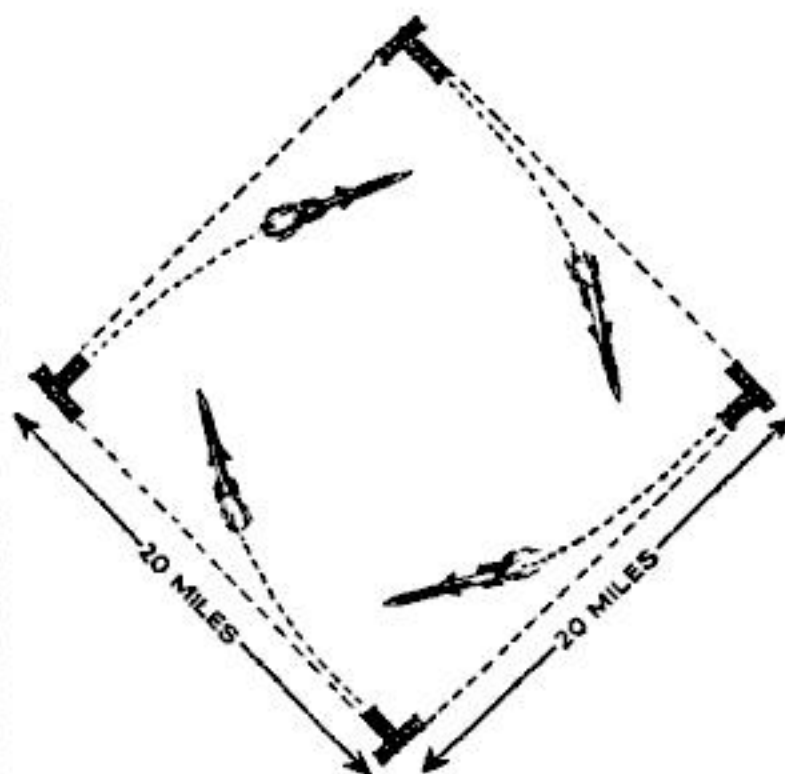
Keeping up with the Goliaths of the car-manufacturing industry, American Motors offers a host of the standard options (nonslip differentials, air springs on the V-8, air-conditioning, etc.) and two that are peculiarly its own—divided, reclining front seats that are individually adjustable, and front-seat headrests. The headrests come in handy when the seats recline, and likely would pay for themselves in safety if the car was banged from the rear.

Touchy about its Rambler being called a "small" car—"It's just small on the outside, it seats six, remember!"—American Motors has altered nothing in its dimensions. The length remains 191 inches, the height 58, and the width 72.18.

Nor have the horsepowers changed—127 for the OHV six, with a special carburetor option producing 138, and 215 for the V-8. Both burn nonpremium fuel.

There are eleven Rambler models, all with four doors, in station wagons, hard-tops and sedans.—Devon Francis.

Brain Busters



The Case of the Four Homing Missiles

FROM the four corners of a square 20 by 20 miles in size, four homing missiles are fired simultaneously as shown in the diagram, so that they home on each other. In doing so, each gradually turns toward the right, always keeping its target on the nose, until all four crash together at the center of the square.

If the velocity of the four identical missiles is one mile per second, how long will they fly before the ultimate collision?

ANSWER: To solve this by math would take a differential equation. But you can answer it by a bit of daring logic. Think of the four missiles as being located, all during their flight, in the four corners or vertices of a square that shrinks and rotates clockwise. Then forget about the rotation and consider the shrinkage only. Since the missiles home on each other, the travel of any one is always along a side of the shrinking square toward the missile at the next corner. So the rate at which the sides of the square shrink is equal to the velocity of the missiles, or one mile per second. As the missiles started 20 miles apart, it will take them 20 seconds to collide.

Adapted from *Puzzle-Math* (Viking Press). Copyright 1958 by George Gamow and Marvin Stern.

Atomic Engines to Power Rockets and

Nevada tests will soon try out newly revealed U. S. plans for sensational flying reactors

By Alden P. Armagnac

ON MESA-RIMMED Jackass Flats in Nevada, right next to our A-bomb testing site, trials of an extraordinary atomic reactor are about to begin. Riding a railway car that serves as a test stand, and towed by a remote-controlled locomotive, it's the prototype of an engine for a nuclear-powered rocket.

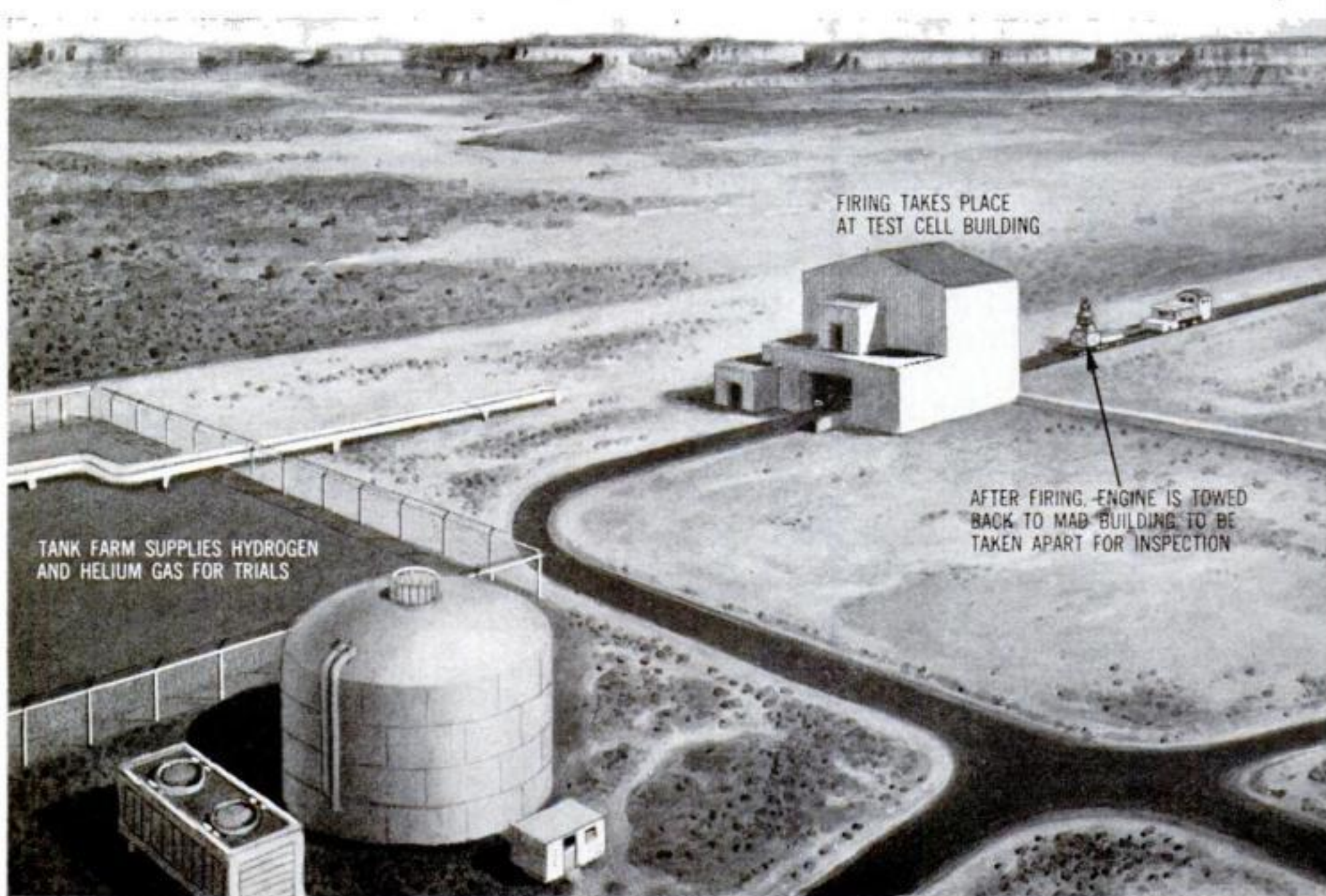
Cylindrical in shape, taller than a man, and weighing perhaps five or six tons, it will impart its fierce heat to a stream of hydrogen gas, which rushes through it and issues from a flaring rocket-style nozzle. Mounted upside-down for trial, the

uranium-fueled engine will direct its fiery blast toward the sky. Watching the fireworks, at safe distance from the unshielded reactor's intense radioactivity, will be the observers of Project Rover—our secrecy-shrouded atomic-rocket program.

Named Kiwi A for a flightless bird, the pioneering engine will serve for "static" or captive firing tests, due to start this month or next. Its purpose is to prove the early feasibility of building an A-engine that will actually propel a rocket.

Soon to become Project Rover's neighbors on Jackass Flats are two equally hush-hush programs, disclosed even more recently: Project Pluto, aiming at an A-powered ramjet missile; and Project Snap, auxiliary A-power for satellites.

Atomic Energy Commission scientists, it's revealed, have upset popular belief that such formidably difficult develop-



TANK FARM SUPPLIES HYDROGEN AND HELIUM GAS FOR TRIALS

FIRING TAKES PLACE AT TEST CELL BUILDING

AFTER FIRING, ENGINE IS TOWED BACK TO MAB BUILDING TO BE TAKEN APART FOR INSPECTION

Missiles

ments as A-powered rockets, missiles and satellites would have to await the distant future. Quietly they've been making such phenomenal progress that actual hardware for all these vehicles is currently being groomed for trial.

Developing the atomic engines is the AEC's part of the task. Meanwhile the Air Force is designing the spacecraft and missiles to put them in. Spectacular possibilities spur the projects.

An A-rocket can be a super-ICBM. . . a giant-satellite launcher. . . an ideal vehicle to explore the solar system. Its incomparable advantage: in payload. Example: It can put a 50-ton moon into orbit to watch the world, take pictures, transmit intelligence—making Russia's 1½-ton Sputnik III look like a toy.

How will a rocket's A-engine work? In a chemical rocket, burning fuel yields

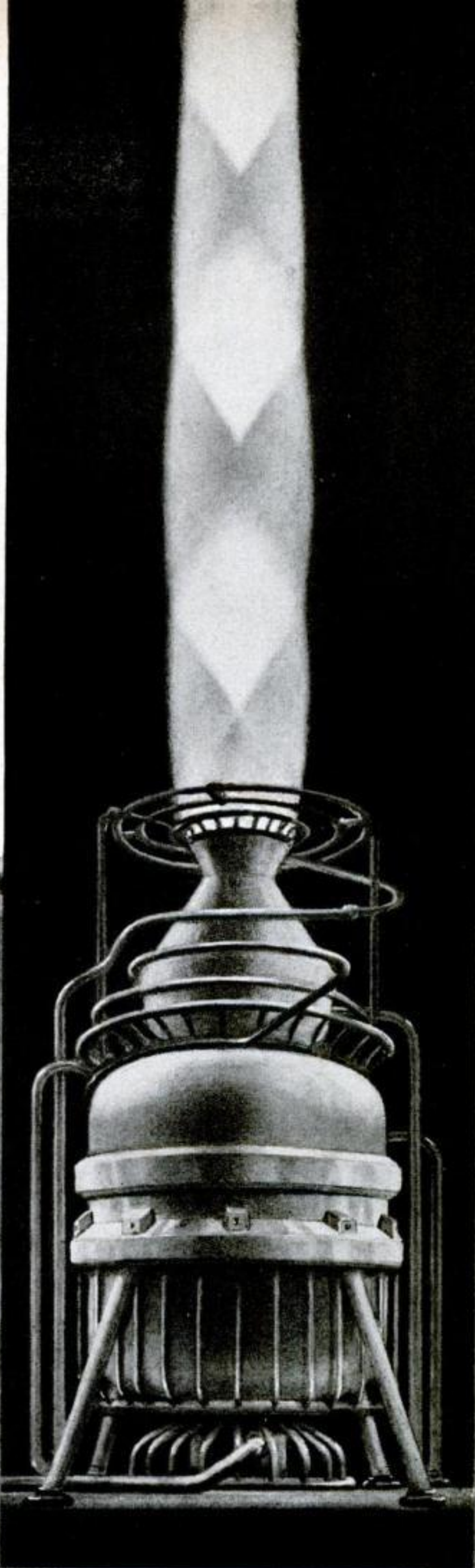


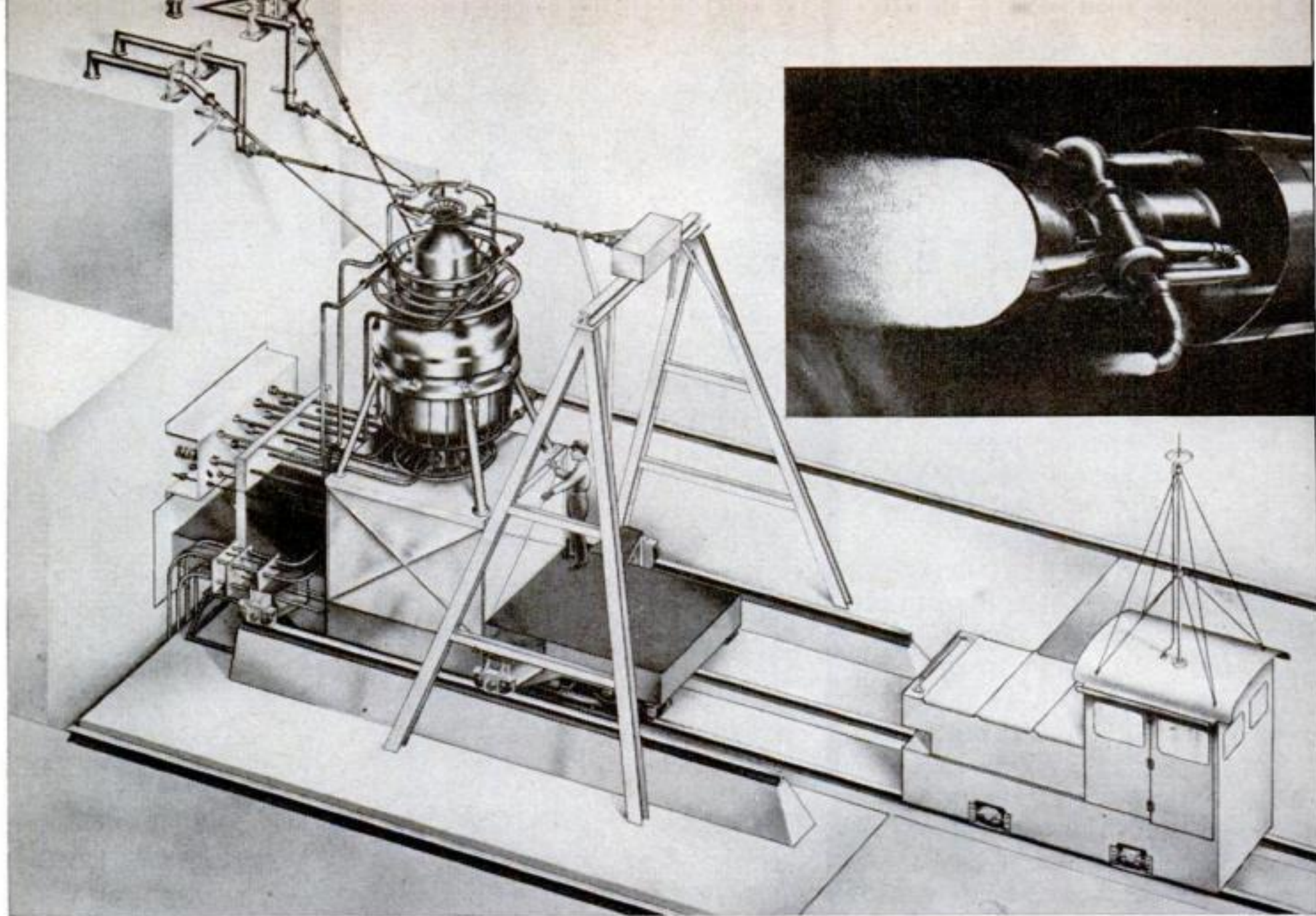
ROCKET A-ENGINE IS ASSEMBLED
AT MAD BUILDING FOR TRIAL

OBSERVERS RUN TRIAL
FROM BLOCKHOUSE-LIKE
CONTROL BUILDING

SPECTACULAR TEST of first rocket A-engine (right) and scene of its coming trials, at newly built Nevada site adjoining A-bomb proving grounds, are previewed by PS artist. Picture of site, intended as schematic view rather than exact map, is based on AEC description.

A. Leyden Frost





heat—and gaseous combustion products, which the heat energy expels from the nozzle to drive the rocket. In an A-powered rocket, the reactor just provides heat, which must be applied to something to make the rocket go. So an A-rocket will also carry a tankful of a “working fluid” or propellant—which is pumped to the reactor, heated by passing through it, and so expelled from the nozzle for propulsive force. For the propellant, most experts favor hydrogen, carried in liquefied form. (Other possibilities: ammonia, methane, even steam.)

First known attempt to put this principle into practice is Kiwi A, the product of the Project Rover team under Dr. Raemer Schreiber at the AEC’s Los Alamos Scientific Laboratory. They call their engine weighty and bulky (“We haven’t tried to shrink it down”) and its thrust “modest,” but it’s quite a machine.

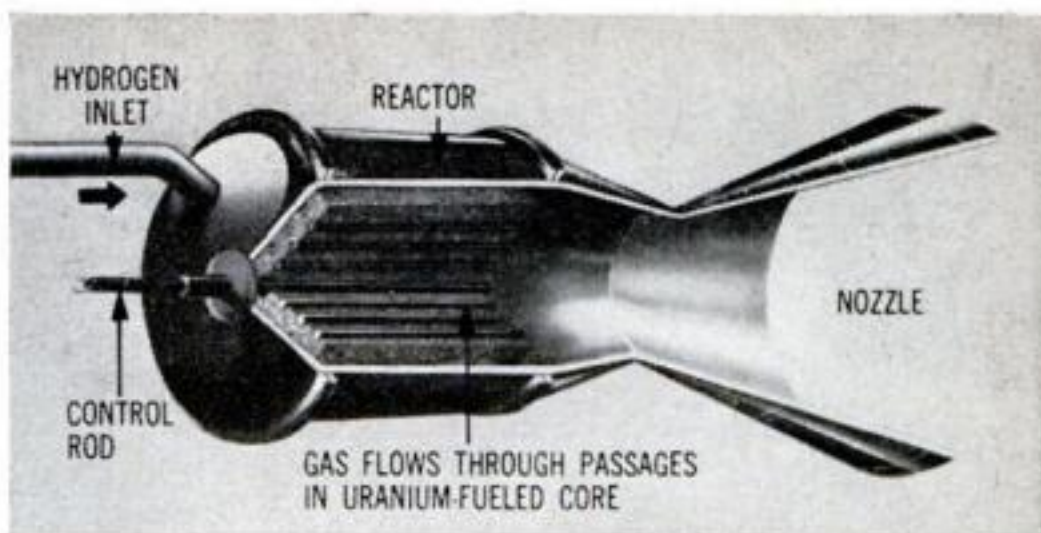
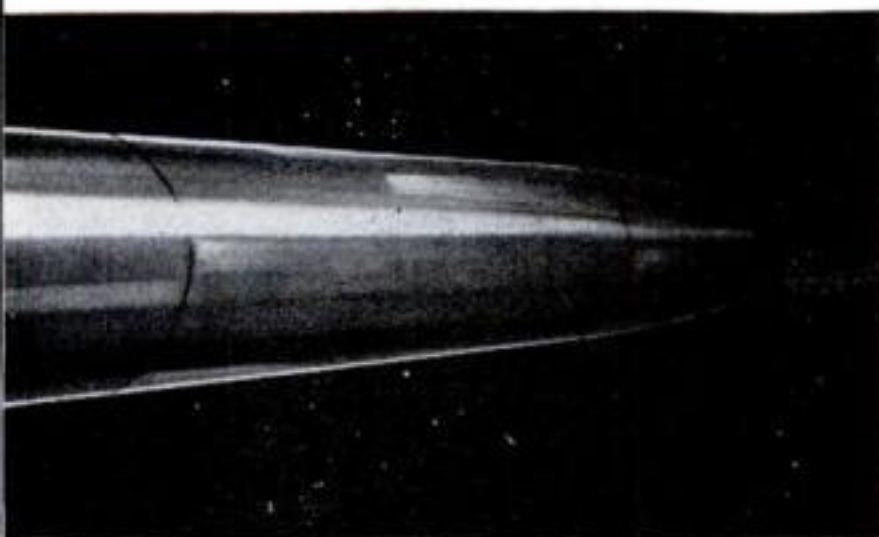
If it attains just a quarter of an Atlas missile’s 360,000-pound thrust, its undisclosed power may exceed that of Shippingport’s great atomic generating station. It’s a high-power reactor, no *if* about that. And they’ll run it at “up to a white-hot heat”—hotter by far than any reactor has been designed to run before.

The hotter the reactor, the better an A-rocket’s performance.

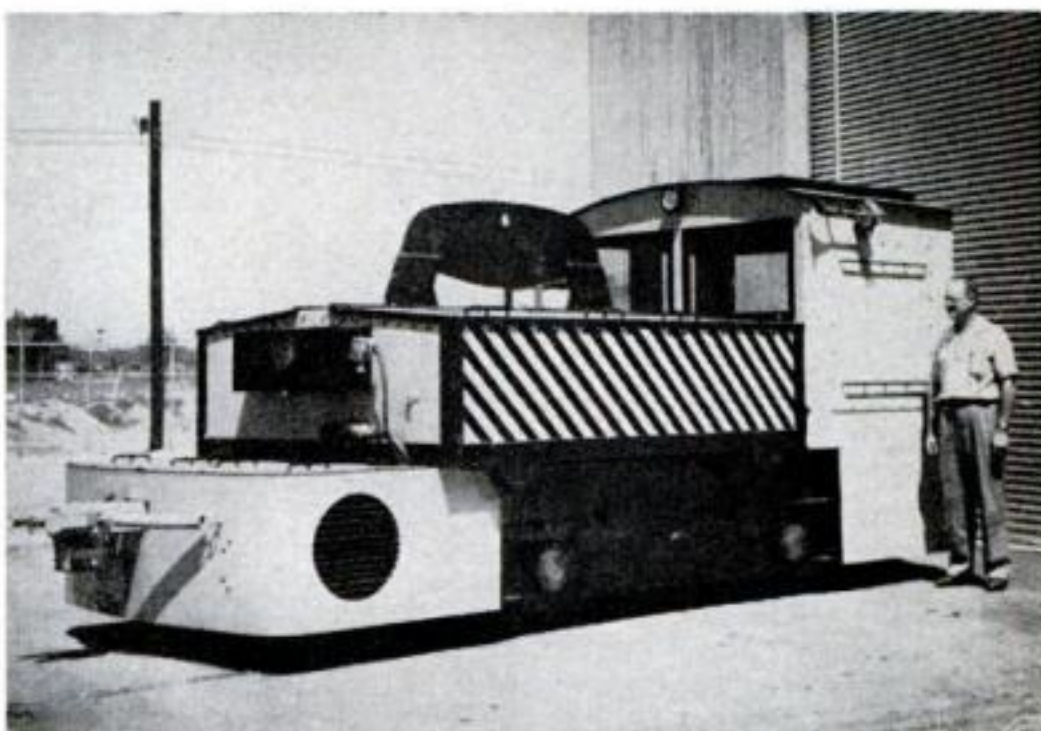
They’ll assemble Kiwi A for trial at its Nevada site’s MAD Building—a nickname that’s short for “mechanical assembly-disassembly.” Trundled on its car to a Test Cell Building for firing, it will be connected to performance-recording instruments, and to a supply of gas from a “tank farm.” During the firing, the unoccupied test cell’s instruments will transmit their readings to observers in a blockhouse-like Control Building. At trial’s end, Kiwi A will be remotely disengaged from its connections—and the radio-controlled locomotive will tow it back to the MAD Building, to be taken apart to see what happened to it.

Initial trials at low power and heat, with helium gas as a stand-in, may take several months. Then Kiwi A will be switched to hydrogen gas, and its control rods will bring it up to full power for an exciting “hot-gas operation.”

The engine’s skyward blast will contain a lot of escaping radioactivity, they expect. That’s why they chose the remote Nevada site to try it out. As with bomb trials, Kiwi A’s firings will await favorable winds—so that fallout will be carried



FIRST VIEW of Kiwi A rocket engine released by AEC (left) shows it on its car in firing position, at Test Cell Building, with locomotive waiting to tow it away. Artist's drawings show an A-propelled rocket in flight (above) and its engine (upper right) as visualized by engineers of Rocketdyne, which is working for Air Force on Project Rover. At right is photo of the radio-controlled, 15-ton "mine-type" locomotive, powered by batteries, that will haul test car bearing Kiwi A on standard-gauge railway track. It's designed for remote operation, including coupling to and uncoupling from test car, since—after a trial—the high-power, unshielded reactor will be too radioactive to approach.

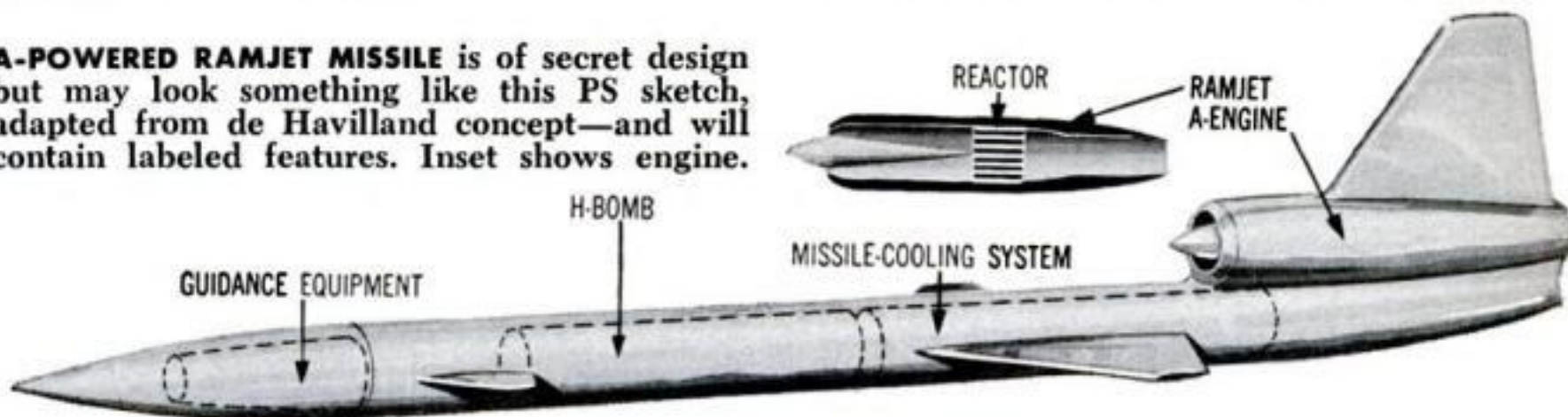


away from the test buildings, and won't make them uninhabitable.

What if Kiwi A should wreck itself and spill radioactive fission products all about? The worst that could happen, the experimenters foresee, is that they'd lose the test car—so radioactive that it might have to be buried. No one outside the test site need be worried; at most, the radioactivity would be a small fraction of what a one-kiloton A-bomb would release. Bombs regularly tested in Nevada have been much bigger.

Lest Kiwi A should prove a flop, or come to a violent end, they'll have an A-engine of alternate design ready for trial within about a year. Successive models of one type or the other will progress toward a flyable version.

A-POWERED RAMJET MISSILE is of secret design but may look something like this PS sketch, adapted from de Havilland concept—and will contain labeled features. Inset shows engine.



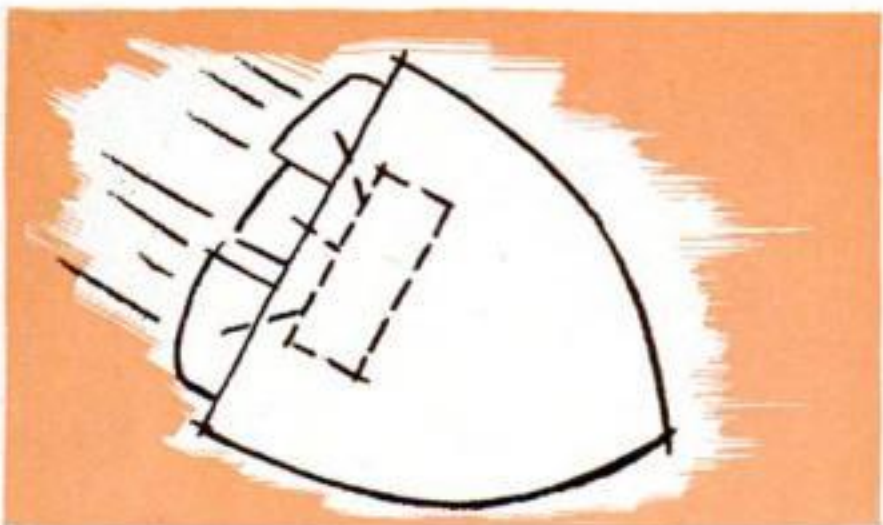
With a reactor ready, the Project Rover team must be well along toward solving its most staggering problem—of finding materials able to withstand a rocket reactor's heat of perhaps 4,000 degrees F. or more. At such heat, for example, fuel elements of uranium metal would melt; they may be using something like uranium carbide. Easing their problem a little, the materials needn't last long.

For a rocket, unlike other vehicles, can travel under A-power only a limited time—until the propellant's used up.

So an A-rocket's climb from earth may have a powered stage as brief as 300 to 400 seconds. Then the propellant tank will run dry. Deprived of the flow of gas that has been carrying its heat away, the engine will burn up—of "self-heat" from



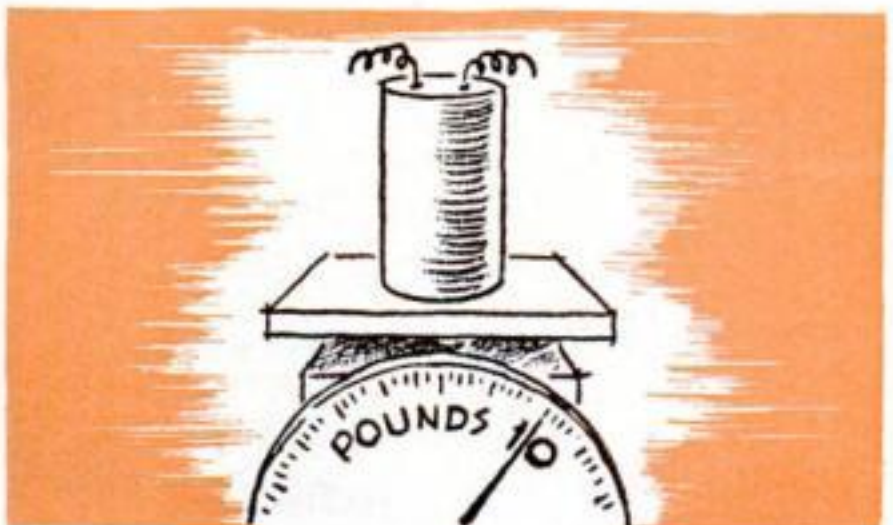
"EVASIVE-ACTION" SATELLITE, one of possibilities of auxiliary A-power, could nudge itself repeatedly into new orbits—and defy an enemy's attempts to track it and shoot it down.



STEERABLE NOSE CONE of A-powered ICBM would have auxiliary engine, possibly actuating trim tabs or jets. Sketch is not of a practical design, but suggests idea.



"HEDGE-HOPPING" SATELLITE could circle globe at moderate altitude, well within earth's atmosphere, by using built-in nuclear ramjet engine to give itself a needed push now and then.



TINY A-POWER PLANT of only 10 pounds would run instruments of small satellite. Isotope's 1,500-degree heat, and thermocouples, yield three watts of current for six months.

the intense radioactivity of its accumulated fission products.

High in the sky, the rocket by that time will already be in a ballistic-missile trajectory, a satellite-launching orbit, or an "escape" trajectory into space, according to its mission.

Launched from an isolated site, an unmanned rocket can blast off directly on its A-engine. That's accepting enough radioactive contamination to prevent re-use of the launching pad for several months. Man-carrying A-rockets may use chemical-fuel boosters to climb above the atmosphere, before turning on the A-power. The reason: Air would bounce back the reactor's radiation, requiring heavier shielding to protect the crew.

Illustrating the kind of A-rocket that's on the drafting boards, a 550,000-pound Rocketdyne design would be double the weight of an Atlas. By still more, it would overshadow an Atlas in size—because of the great bulk of the liquid hydrogen, only .07 as dense as water, that makes up most of its contents and weight. Yet an A-engine of only 750 pounds, they figure, would suffice to propel this giant.

Rocket engineers drool over an atomic engine's twofold or threefold improvement in what they call "specific impulse"—the ratio of the thrust to the rate of propellant consumption. In layman's language, that means a sensational increase in payload capacity. A 22,000-pound Vanguard rocket's payload, a tiny 21-pound satellite, represents about 1/10 of one percent of total weight at launching. In contrast, a fantastic 20 percent of an A-rocket's launching weight can be payload. Interesting things, besides launching satellites, can be done with it.

For one, it's suggested, the nose cone of an ICBM's warhead could carry a steering engine. And so an A-propelled ICBM, which could outrange an Atlas, could also score more accurate hits.

A payload on a grander scale would be a second A-rocket. Such a "two-stage Rover," they say, could navigate anywhere in the solar system this side of Jupiter. But a single-stage Rover would excel today's multistage chemical rockets.

Best-informed prophets put a flying A-rocket at least two or three years away; not more than eight years.

Sooner than that, a sleek, stubby-wing-

[Continued on page 260]



Typical automatic shotguns: recoil-operated Winchester 50, gas-operated Remington 58.

How Automatic Shotguns Work

THIS month 16,000,000 Americans are stalking forest and marsh, eyes sharp and trigger fingers itchy for duck and rabbit. Increasingly, they pack an ultramodern automatic shotgun.

The automatic fires every time you squeeze the trigger—there's nothing else to do but aim. This means you can place more shot in the target area in a given time. You get a second crack at a nimble rabbit, maybe two quail when your dog flushes a covey.

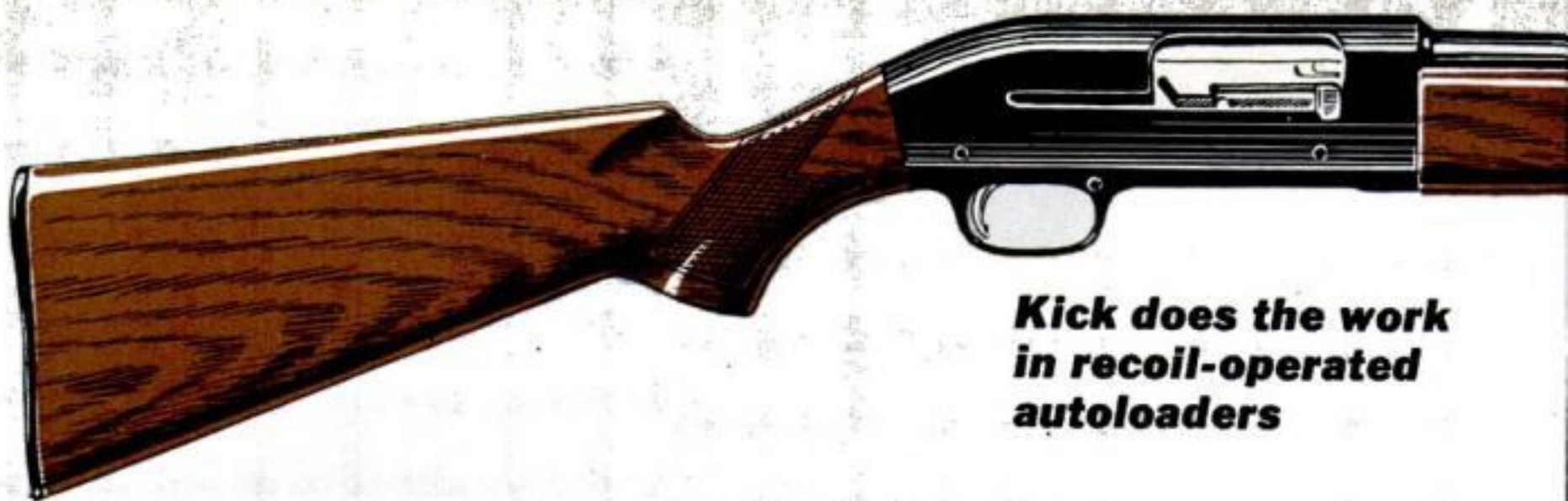
You have to load the automatic (two to five shells, depending on make), and cock the hammer for the first shot. But after that, the gun itself takes over. One squeeze and it fires, flips out the spent shell, shoves a fresh one into the chamber, and cocks itself ready to fire again . . .

all in thousandths of a second. A built-in safety prevents continuous machine-gun-style firing (technically, these guns are semi-automatic—you have to squeeze the trigger for each shot).

Gun designers use two different methods to make automatic shotguns automatic. Both convert the energy of the exploding shell to the work of reloading and cocking. In one type (chart below lists details make by make), recoil—the backward movement of the barrel, or separate chamber—actuates the mechanism. In the other, the push comes from expanding gas from the explosion, which is bled off through a small port in the barrel to move a piston. For the complete how-it-works picture story on automatic shotguns, please turn the page.

Auto-Loading Shotguns: Who Makes What Types, and Cost

ACTIONS		MANUFACTURER	GAUGES	SHOTS	STARTING PRICES
LONG RECOIL	Browning "Auto"	Browning Arms, 1706 Washington St. Louis 3.	12, 16	5	\$128
	Remington 11-48	Remington Arms, 939 Barnum Ave. Bridgeport 2, Conn.	12, 16, 20, 28, .410	5 4	\$123
	Savage 755	Savage Arms, Chicopee Falls 35, Mass.	12, 16	5	\$111
SHORT RECOIL	Browning "Double Automatic"	Browning Arms, 1706 Washington St. Louis 3.	12	2	\$128
	Winchester 50	Winchester-Western New Haven 4, Conn.	12, 20	3	\$134
GAS OPERATED	Remington M-58	Remington Arms, 939 Barnum Ave. Bridgeport 2, Conn.	12, 16, 20	3	\$136
	J. C. Higgins 66	Sears, Roebuck, 925 South Homan Chicago 7.	12	5	\$100



**Kick does the work
in recoil-operated
autoloaders**

1 SQUEEZE the trigger, the hammer hits the firing pin—and *bang!* Explosion pushes both ways: forward on shot, backward on the chamber.

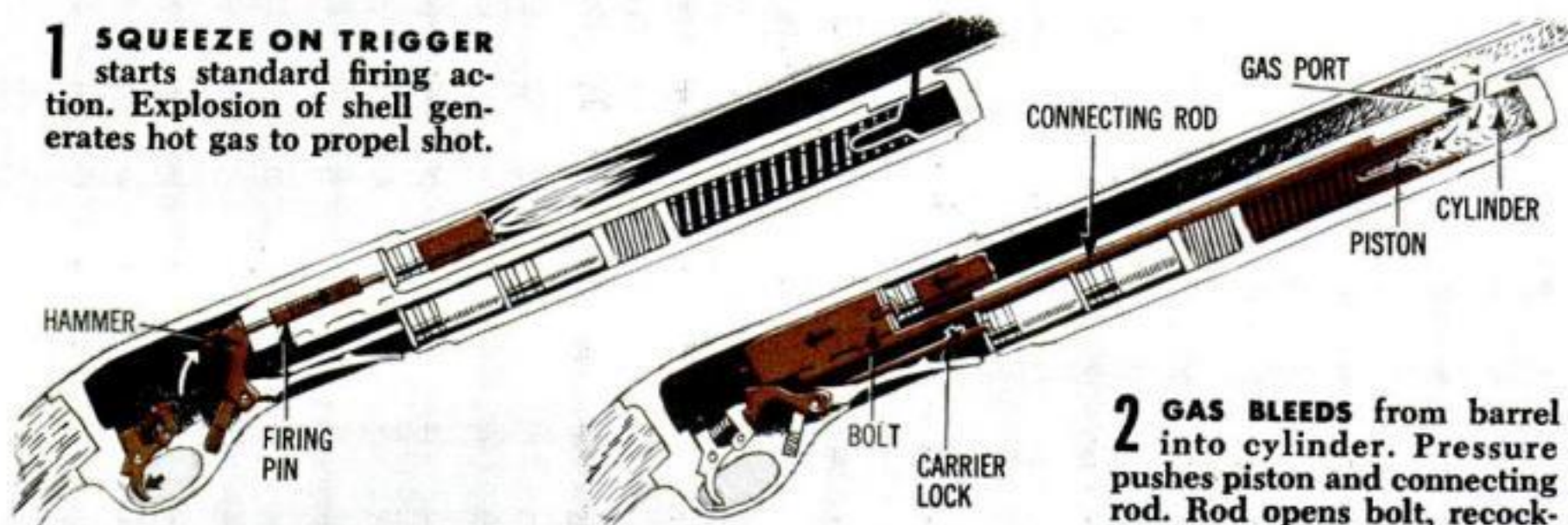


2 BACKWARD FORCE moves chamber and bolt 1/10 inch. This kicks inertia-rod pin so that rod continues travel. Rod recocks hammer.



**Gas-operated shotgun
taps the blast to
work its machinery**

1 SQUEEZE ON TRIGGER starts standard firing action. Explosion of shell generates hot gas to propel shot.



2 GAS BLEEDS from barrel into cylinder. Pressure pushes piston and connecting rod. Rod opens bolt, recocking hammer, opening lock.



AN EXPLODING shell pushes back on the gun as well as forward on the shot. You feel it at your shoulder—that's the kick. This recoil operates the machinery in many automatics, usually by sliding the barrel (how far the barrel travels

back determines whether the action is called "long recoil" or "short recoil"). In the Winchester, the barrel is separate from the firing chamber, and recoil slams back only the chamber. The chamber's travel is short—only 1/10 inch.

3 FULL MOVEMENT of inertia rod pulls bolt far back, working pin that ejects spent shell. Carrier lock pivots, admitting new shell.



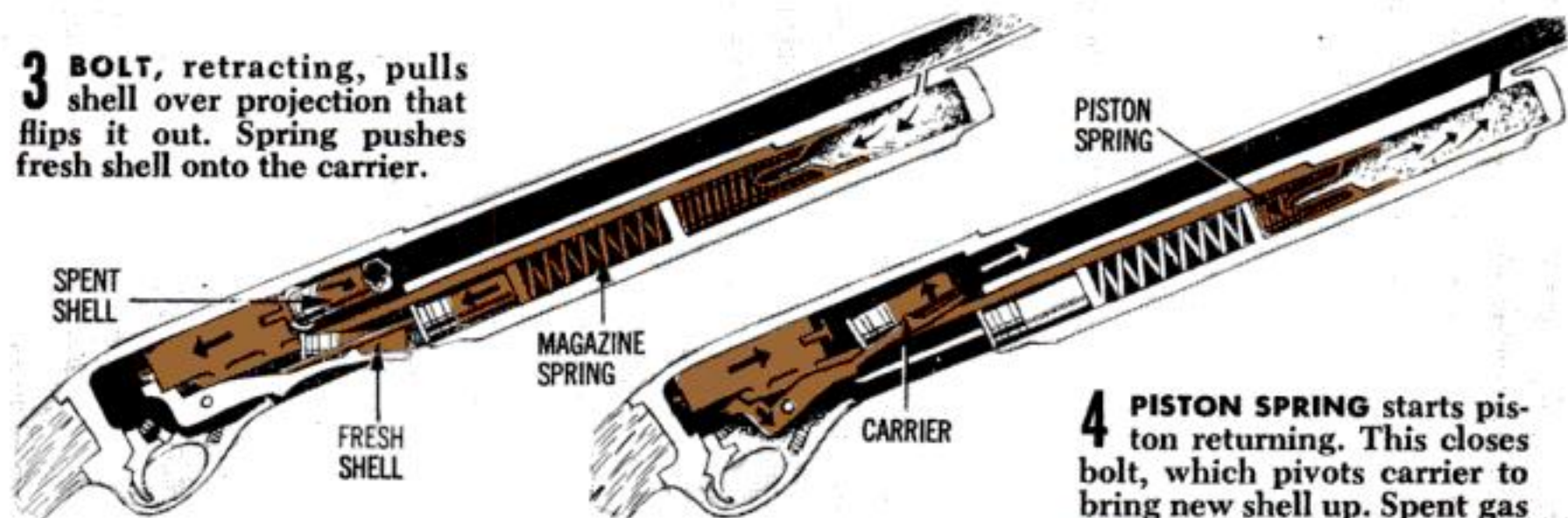
4 SPRING starts inertia rod returning. Rod moves bolt slightly, pivoting carrier to lift new shell. Rod then returns bolt and new shell.



THIS type of gun has a cylinder and piston much like the ones in an auto engine. A little expanding gas, left over from the main job of propelling the shot, gets into the cylinder through a tiny opening partway down the barrel. The

gas drives the piston back, forcing out the spent shell, loading a new one into the chamber and recocking the hammer. The Remington action shown here is typical of gas-operated autoloading guns. Here's how it works.

3 BOLT, retracting, pulls shell over projection that flips it out. Spring pushes fresh shell onto the carrier.

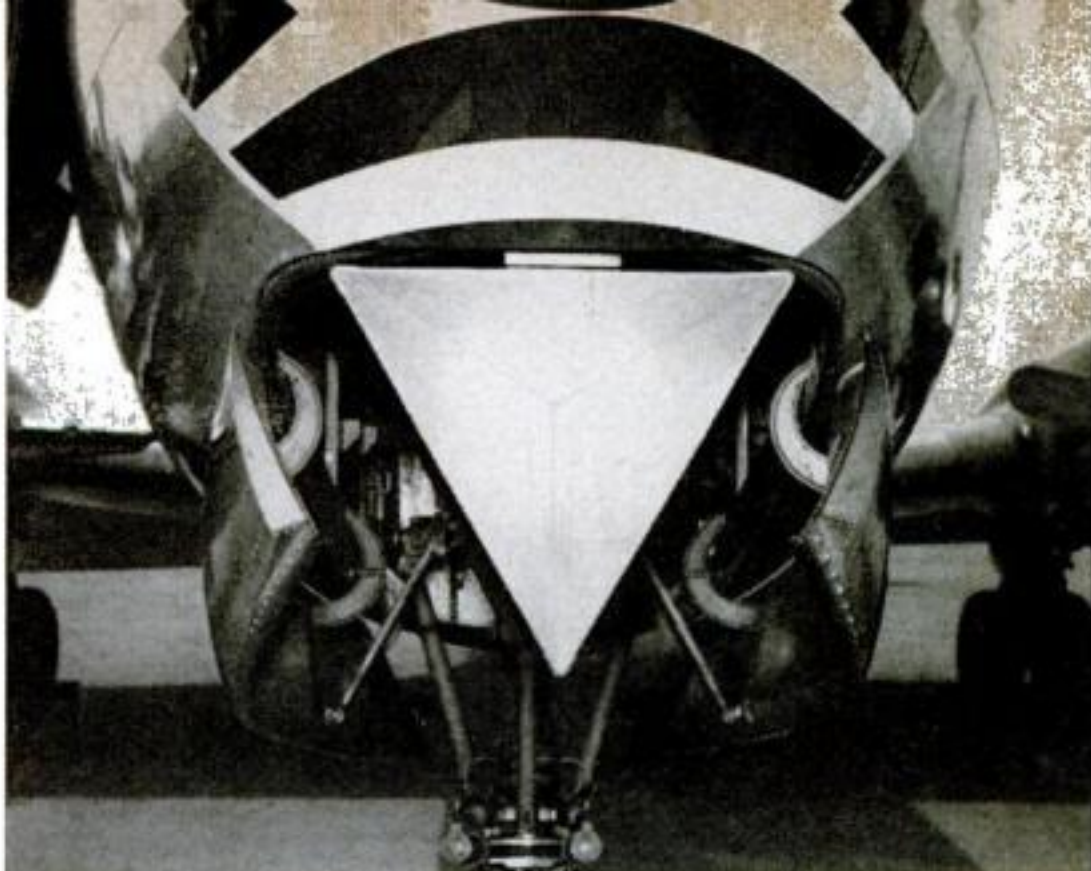
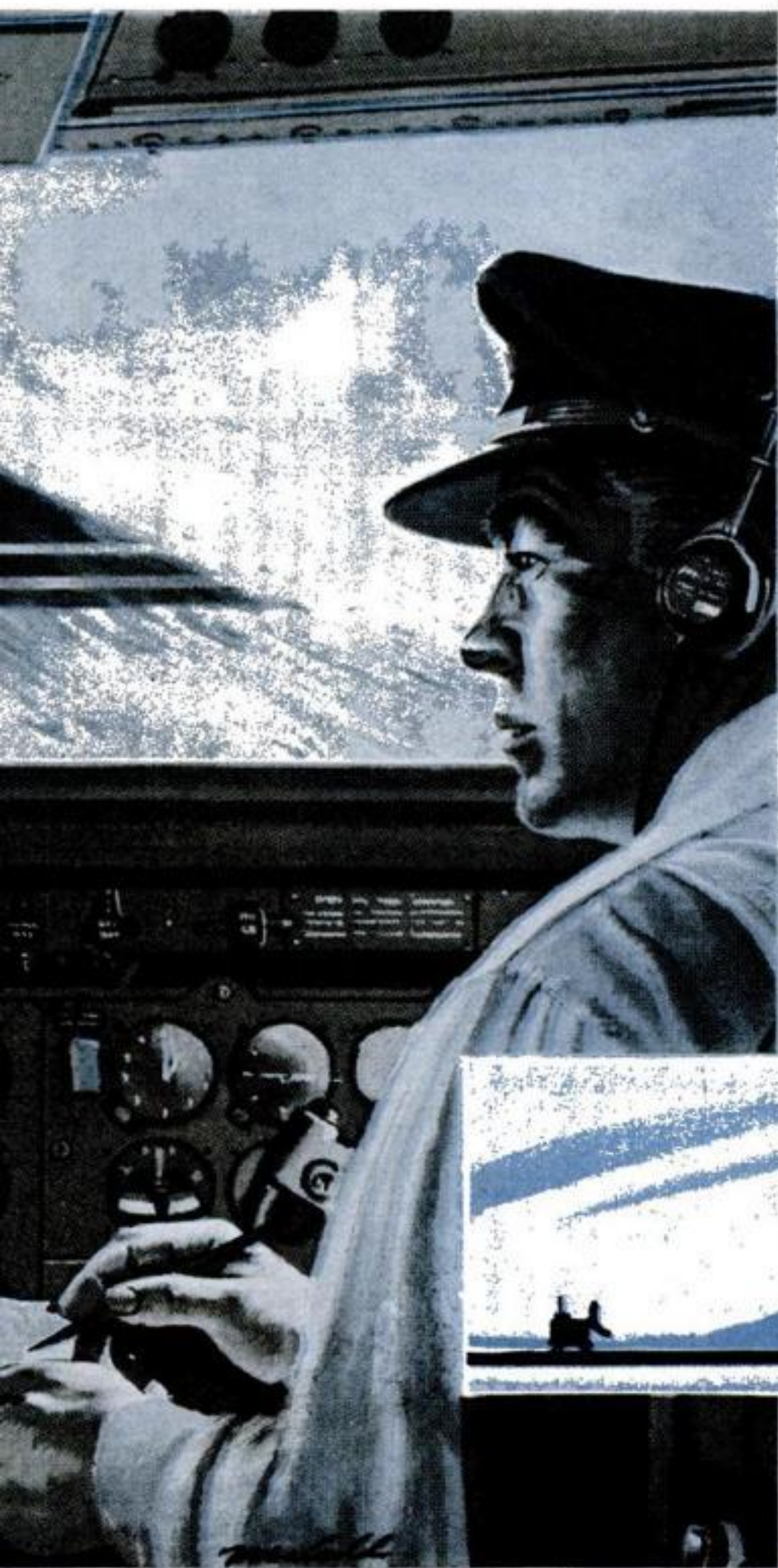


4 PISTON SPRING starts piston returning. This closes bolt, which pivots carrier to bring new shell up. Spent gas escapes through port.

No-Hands System to Land Airliners in Any Weather



With the help of a robot brain, science makes regular airline schedules possible even when airports are socked in by snow or fog



THREE-SIDED REFLECTOR, of aluminum, bounces back radar tracking signals. Mounted high on the front undercarriage "leg," the reflector is the sole piece of equipment added to airplane.

AN AIRPLANE as big as a house swooped in over a runway at Seattle the other day without a hand on the controls. It floated there for a few seconds and then gently—all by itself, as obedient as a trained pooch—touched its wheels down.

In the captain's chair up front sat a pilot. It would be stretching the truth to say that he sat there quietly. He didn't. He fidgeted. Pilots are like that when they're confronted with something new—even weird. But he managed to keep his hands in his lap until the weight of the airplane was on the wheels.

This wholly automatic landing by the new Boeing 150-passenger jet airliner set a fresh milestone in the annals of flight. It may well portend spectacular changes in airliner operation in the near future, once the system gets full CAA approval.

The airplane was greased on to the run-



ALS TAKES OVER when plane is flown through a radar "gate" two or more miles from airport. Donald Stuart, director of government's technical development center, Indianapolis, says unofficially, "As a fully automatic landing system, it's the best thing I know of."

**A van and a box with a cone attached
are all that an observer sees**



DC-7 lands without a hand on controls as radar (left) feeds information on airliner's position

way by a spanking new Automatic Landing System (ALS) designed to get airplanes to the ground in weather when even the birds are walking. It's perfected. It has been used in more than 2,000 landings so far without a slip. The airplanes it has landed included big fellows like the Boeing and DC-7 airliners, and an F-86 jet fighter. It has even landed planes on an aircraft carrier at sea—compensating for the pitch and roll of the deck.

Its use on a jet airliner—soon to go into transatlantic and transcontinental service—was the ultimate test.

The system is precise, so much so that men on the ground monitoring its operation can tell by their instruments if a pilot aboard an automatic-landing plane fiddles with the controls.

"Davey!" the monitors for the Bell Air-

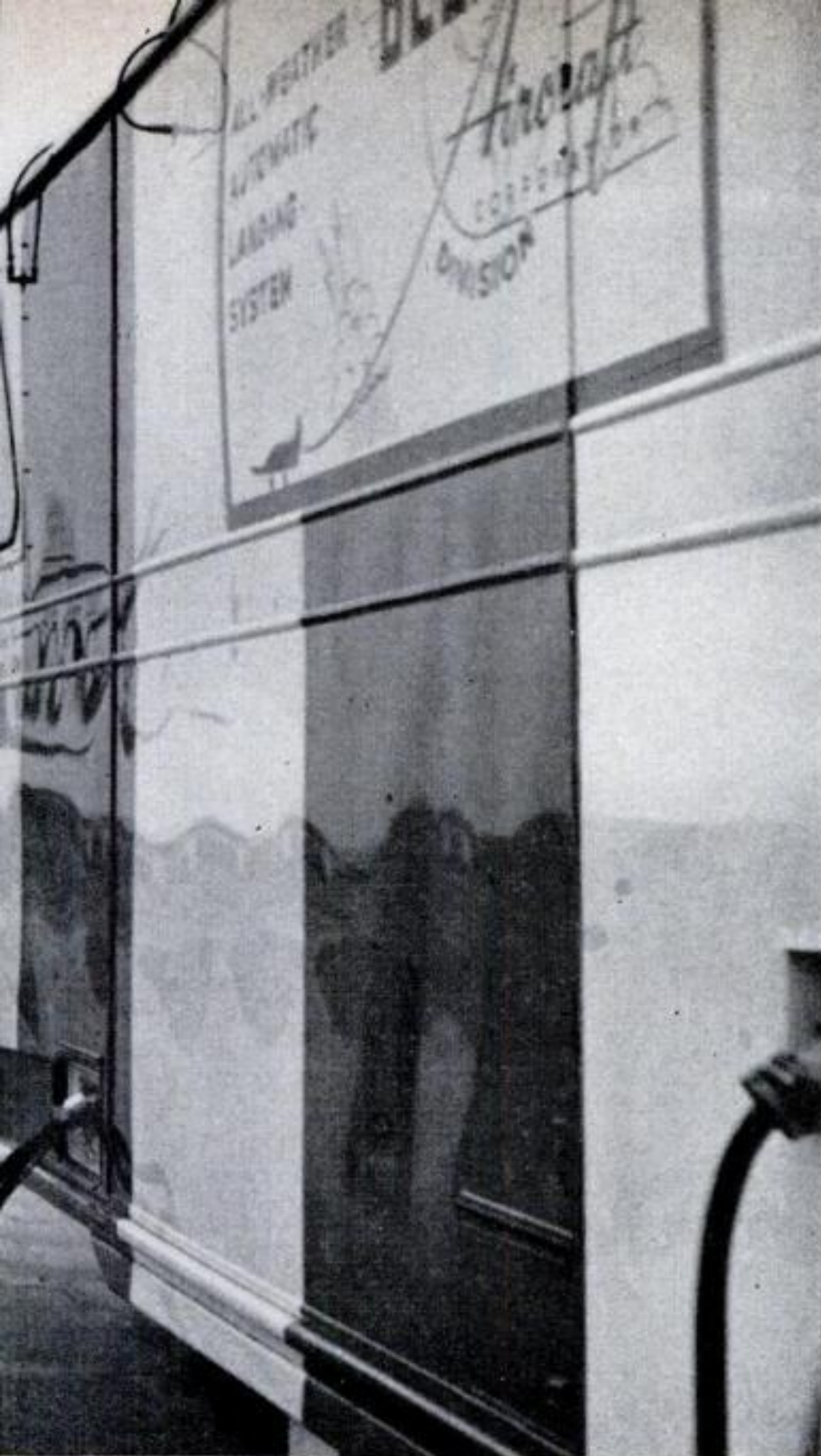
craft Corp., at Niagara Falls, N. Y., radioed a company pilot the other day as he was getting his first dose of hands-off landings. "Did you grab the stick?"

"Yeah," Davey reluctantly radioed back, "a little."

The monitors knew—the landing hadn't been as smooth as it should have been.

Bell Aircraft, which devised this piece of legerdemain, is confident that the day has arrived, at long last, when airliners can operate with the regularity of trains, regardless of weather.

With two such systems guiding and controlling alternate aircraft, Bell figures that it could bring in upward of 100 planes an hour in thick weather on a single runway. That compares with about 12 an hour at an average airport when the



to computer (right) to command flight path.

ceiling and visibility slide to their minimums—clouds at 200 feet off the deck and half-mile visibility.

It's about time. Day by day, air traffic is getting heavier, and most airplane accidents are landing accidents. How often have you sat there nervously as you orbited over an airport waiting for the control tower to reach your airliner's number in the cloud-shrouded "stack"?

The essence of simplicity as far as the airplane is concerned, Bell's automatic landing system adds only one item to the plane's equipment. That's three pieces of aluminum riveted together to form a corner, like that where two intersecting walls meet a ceiling. The sides of this "corner reflector" are eight to 14 inches long, depending on the type of airplane to be landed. It weighs three pounds, or less.

Normally, the device would be attached to the top of the plane's front landing-gear "leg."

Even that isn't necessary. Bell pilots have made landings in a twin-engine transport merely by holding up one of these corner reflectors against the inside of the windshield.

Sounds ridiculous. But there you are—add the reflector and a plane is ready to be landed hands-off. The reflector focuses the radar signal.

The system is simple from the airplane's—and, indeed, the pilot's—standpoint. But it's something else again in ground equipment. There it's as complicated as an analog computer, the electrical robot that does problems in higher mathematics in a flash. The "brain" of the automatic landing system, as a matter of fact, is an analog computer.

Now, here's why the landing system can be made to work:

- All airline transport planes are equipped with automatic pilots. Essentially, these are gyroscopes that keep a plane on a given course and at a given altitude. Autopilots can be made to respond to radio commands.

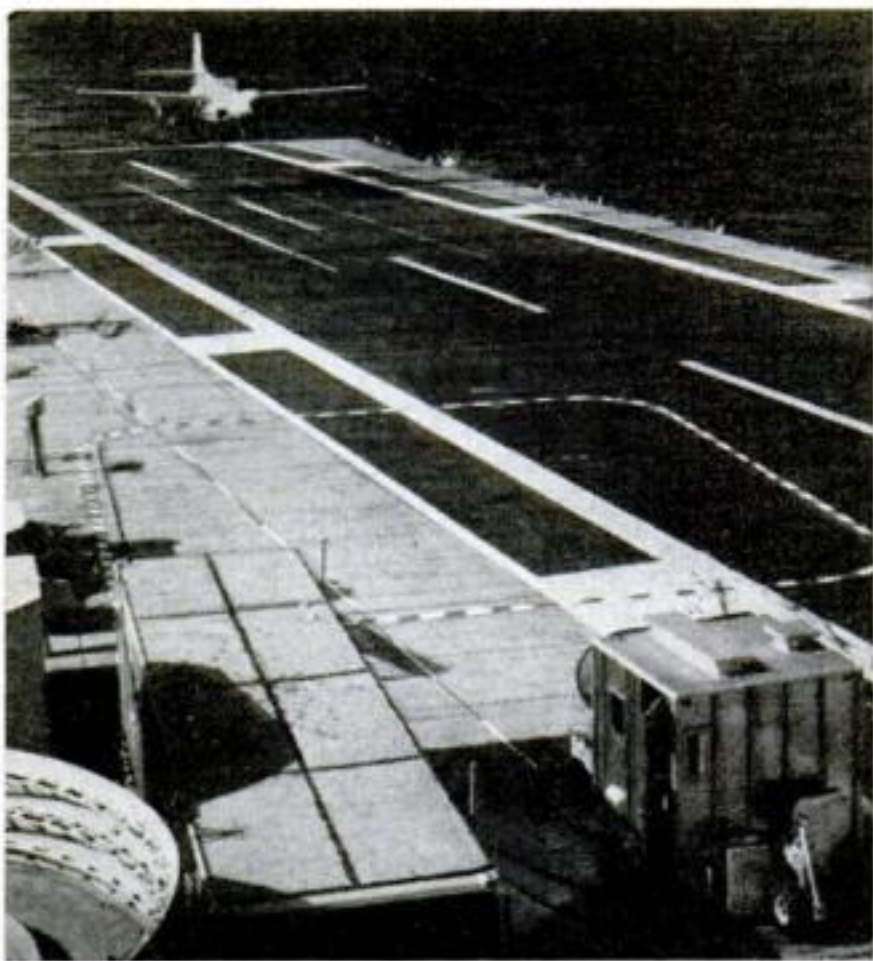
- All transport airplanes are equipped with radio receivers to pick up signals from the Instrument Landing System (ILS) installed at all major airports. The pilot only needs to keep two needles crossed on the face of a dial (by corrections in his altitude and direction) to line up with the runway and follow a "glide path" to a touchdown.

Right there are the essential elements of an automatic landing system. Just hook the incoming ILS signals to the automatic pilot, and the man at the controls can sit back and relax.

It sounds too easy—and it is. The fact is, the ILS has been hooked up to the automatic pilot with fair success. But—the trouble has been that the ILS signals get erratic at altitudes of 200 feet and below. The human pilot has to take over. If he hasn't broken out of his cloud cover by then, he's in trouble. His own reaction time to emergency, and the airplane's responses to the controls, are too slow for that skimpy an altitude.

What's needed to put precision into an automatic landing system are two things:

- A tracking device as sensitive as a bloodhound's nose to follow exactly, and



LANDING ON CARRIER, Navy plane was not only guided to near-perfect hook-on, but was given flight path by computer (right foreground) to compensate for deck's pitch and roll.

report, the movements of an airplane preparing to land. That's radar.

• And some means of establishing a proper glide path, correct to the inch, for two or more miles from the inbound lip of the runway and right down to the ground (lined up with the runway, of course), and of comparing this with the position and glide path an airplane is actually following. That's the analog computer, the calculating "brain."

Add a way to correct a plane's course and altitude, and you've got it.

Here's how it works:

The airplane-candidate for an automatic landing is flown into a "gate" two or more miles from the runway. The radar may actually have picked up the plane seven or eight miles away, but the computer doesn't say, "Okay, now!" until the plane sails through this gate.

A radar-thing out there in the air, the gate is 400 to 500 feet in depth and several thousand feet wide. How deep and how wide depends on how far it is from the runway lip—the radar pattern broadens with distance. The plane can be brought to the gate by ILS, by Ground Control Approach radar, by any one of several navigation systems such as the military's experimental TACAN, or simply by voice control from ground to pilot. The landing radar and computer aren't fussy.

The pilot throttles down his engines for his glide, flattens his blade pitch if he's flying a prop job, extends his flaps for more lift, puts his wheels down, and settles back in his seat.

The rest is duck soup—telling the airplane's automatic pilot what to do to get on the prescribed glide path and to get lined up with the runway. The ideal glide path fixed by the computer at a given point is, say, 1,125 feet above ground level. The plane is at 1,400 feet. The computer subtracts 1,125 from 1,400, and energizes a command radio to say to the automatic pilot, "Wups! You're 275 feet too high." It corrects the same way to line up the plane with the runway.

Because these commands go out *10 times a second*, the autopilot doesn't over-control in making corrections. Its movements of elevator, ailerons and rudder are "modulated," as the engineering fraternity puts it.

Once the plane gets lined up with the runway and on the glide path, it sticks there like glue.

A few feet above the runway, the computer "flares" the plane—brings up the nose so it will settle on the main wheels. Bell prefers to add a control for the throttles, so a pilot won't be tempted to fiddle with anything during the entire landing operation. But engineers long ago learned to be deferential toward the pilot clan, and if a pilot wants to jockey his own engines, it's okay with them.

The Bell system, the only thing of its kind in the world, has a history. About seven years ago the U.S. Navy began worrying over the hazards of carrier landings, especially with the new jet fighters and fighter-bombers—as tractable as mules in wave-offs and go-arounds—under bad weather conditions. When the hook on a Navy jet's tail missed the arresting wires on the deck, it was touch-and-go for seconds to save airplane and crew.

So the Navy asked for bids on an all-weather landing system. Bell got the nod. Its proposal was accepted because it planned to use radar, as an airplane tracker, with a frequency of 35,000 megacycles. That's so high that it is above the highest officially designated* band, the superhigh frequency (SHF), which ends at 30,000. There's a reason for the frequency—it affords precision.

[Continued on page 236]

What's New in the Chrysler Family for 1959

Livelier styling, bigger engines, swiveling front seats highlight the five Chrysler Corporation cars

By Harry Walton

CHRYSLER'S stack of chips for the 1959 market is 30,000 brand-new parts. Eighty percent of these are for styling changes, which gives a pretty fair idea of what's new in the Chrysler stable. There are plenty of changes, but they don't add up to a greatly different look.

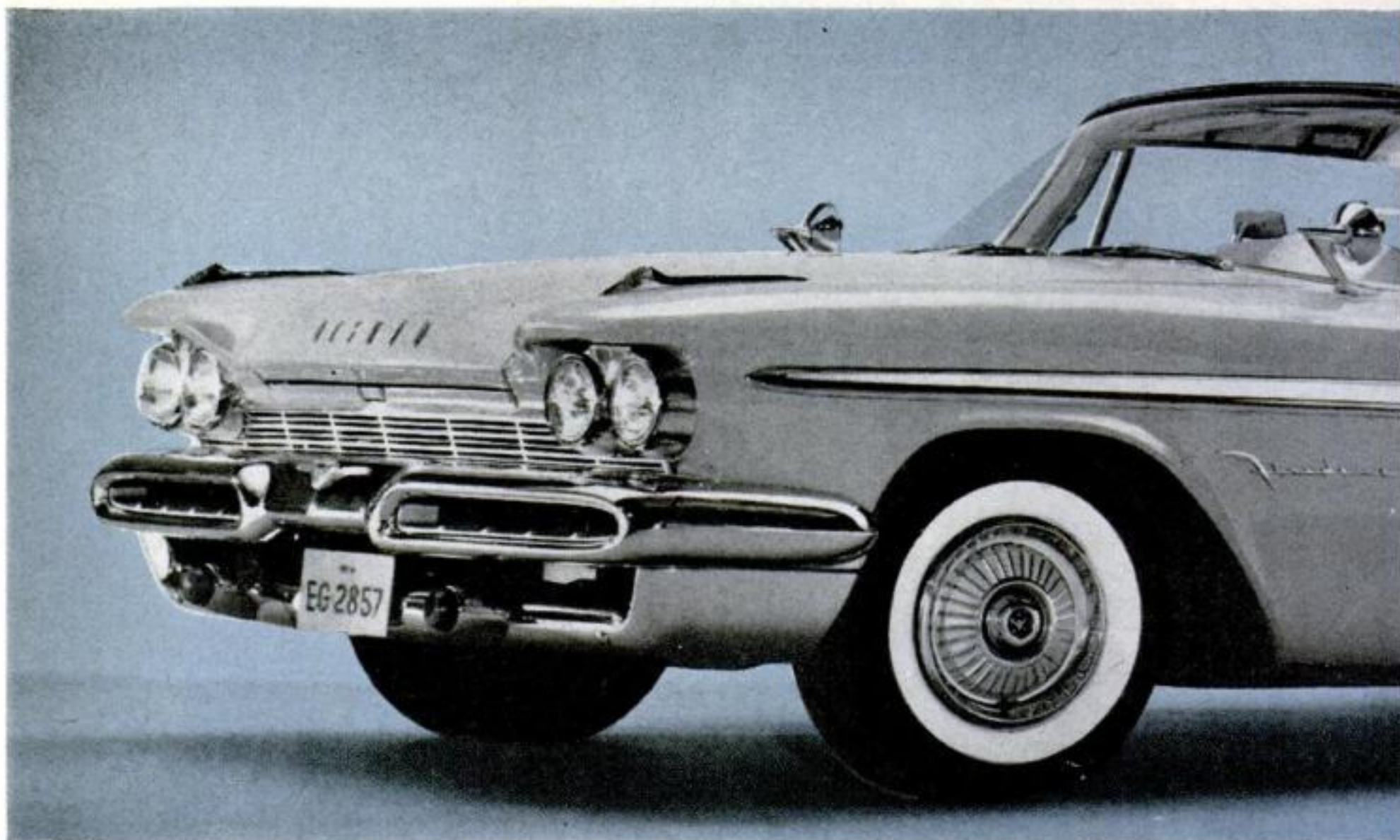
What Chrysler is betting on is that Mr. and Mrs. America will buy plushier, more luxurious cars. Its chips, in the form of heavy tooling investments, are down on new sheet metal, showy trim, fancy "jewelry," massive front-end treatments, and swank interiors, including new instrument panels, steering wheels and seats.

What's new mechanically? Chrysler's divorce from the hemispherical combustion chamber, to which it was long and truly wed, becomes final this year. "It's still the finest combustion chamber ever designed," some engineers say nostalgically. But the stone-cold facts

.....

DE SOTO GOING PLACES: Bold line-up of bull's-eye taillights and markedly flaring tail fins are symbols of Chrysler-line restyling for '59.





Long, low look is continued in the '59 De Soto four-door hardtop. New roof panel yields

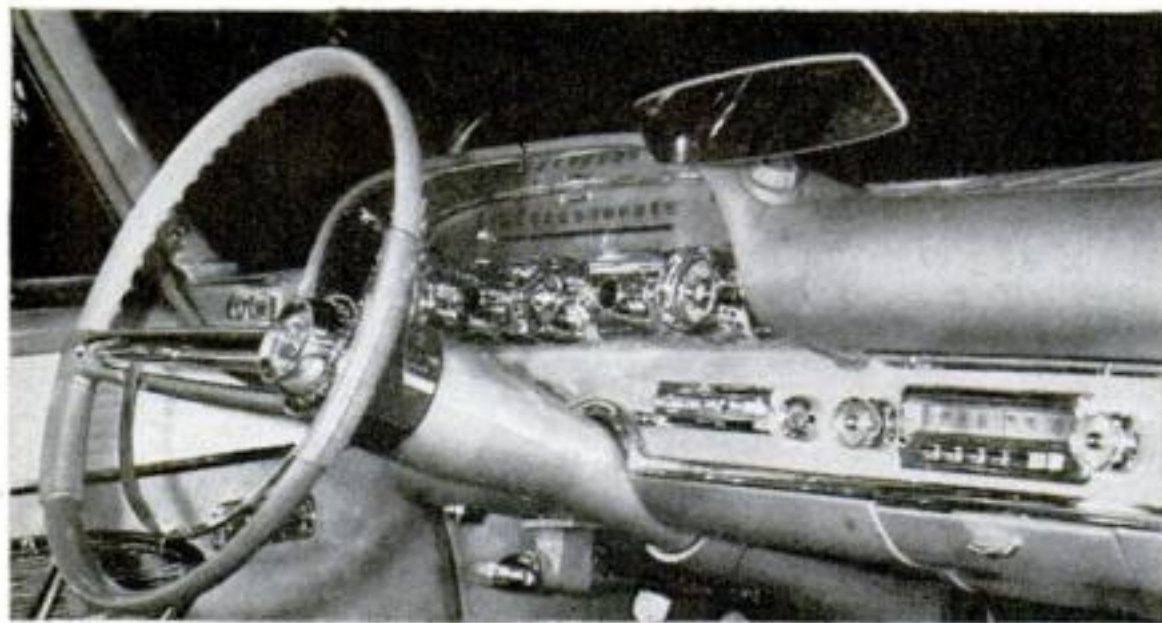
were that machining was costly, valve spacing poor, rocker-arm hardware complex, and engine weight excessive. These faults the wedge-shaped combustion chamber, already adopted by competitors, had licked.

De Soto sports a swank new dash

The new Chrysler engines, initiated last year with the new "B" V-8 [PS, Oct. '57] have wedge-shaped chambers, big valves for fast breathing, in-line valves with a single row of rocker arms for each bank.

They're lighter, easier to service, and so durable, Chrysler says, that 25,000-mile wear tests had to be doubled before they showed any effects.

Displacement is up. Blocks are bored larger to provide more powerful standard engines on top models of the Dodge and De Soto lines, Chrysler Windsor and Saratoga. For the New Yorker, 300E and Imperial

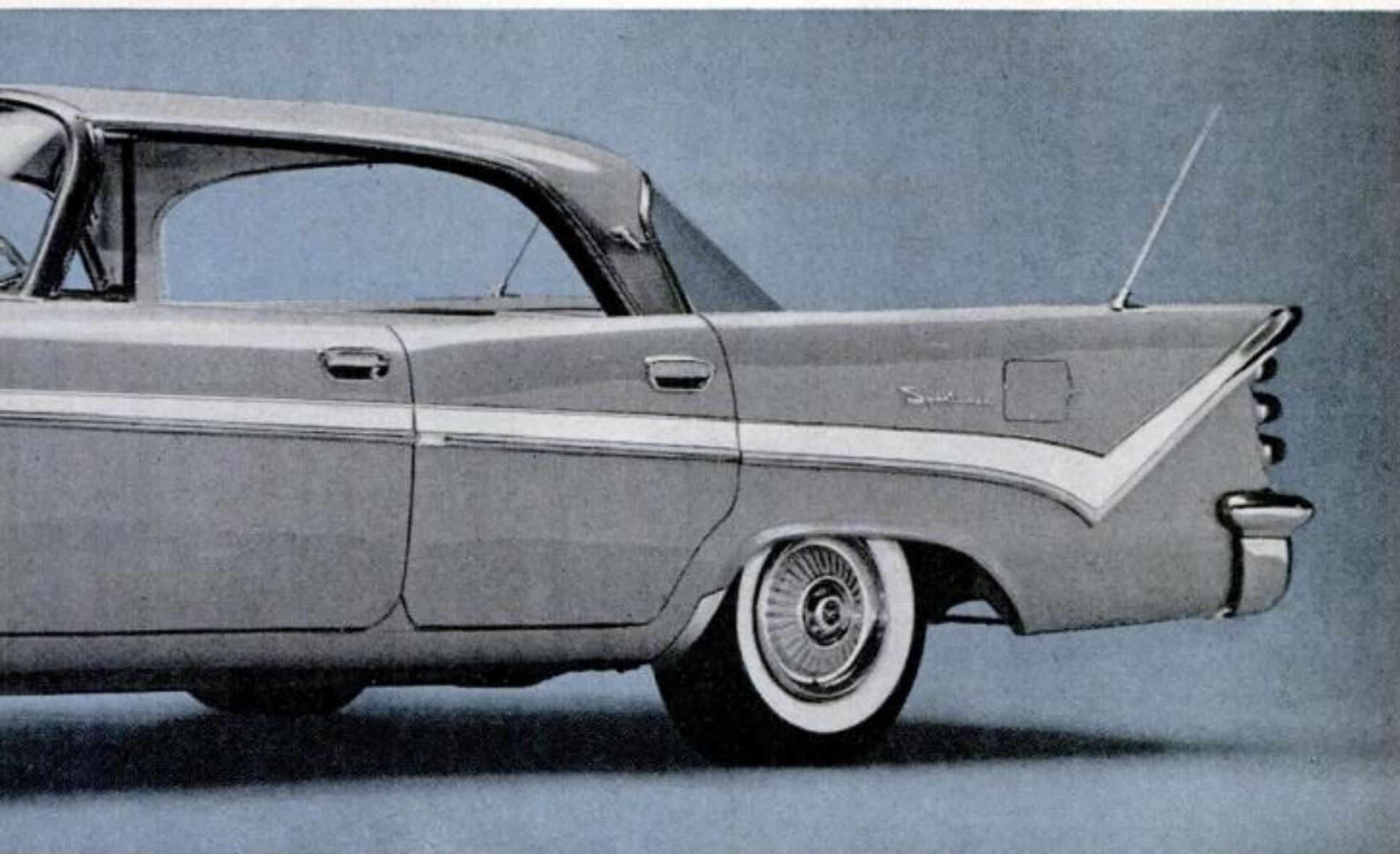


Bar speedometer tops instrument panel of this De Soto. New pushbutton controls for heater and vent are to right of steering column.

there is a more generously oversquare 413-cu-in. engine (4.18 inches bore, 3.75 stroke).

High-performance power plants with special camshafts, valve springs and four-barreled carburetors are optional on all models, including Plymouths.

Chassis-wise, the big news is optional air-and-steel rear suspension. Refusing last year to be stamped into air suspension, Chrysler this year sticks to torsion-bar suspension in



increased head room and leg room. Front end, fenders, rear quarter panel are restyled.

the front, but adds airbags to leaf springs in the back.

This belt-and-suspenders deal provides automatic leveling where it's really needed, say Chrysler engineers, to get higher average ground clearance, constant headlight alignment and smoothest ride regardless of loading. Nor is Chrysler alone, for Buick, too, has dropped airbags in front [page 84].

Low-rate leaf springs support 75 percent of the Chrysler load, nylon and rubber airbags 25 percent. If the air system is out of action, you can still drive the car.

Happy with its successful torsion-bar suspension at the front, Chrysler has touched it up a bit. Bars are shorter, weigh four pounds less. Ball joints have a new rubber seal. A new cam adjustment for caster and camber affords more precise wheel alignment.

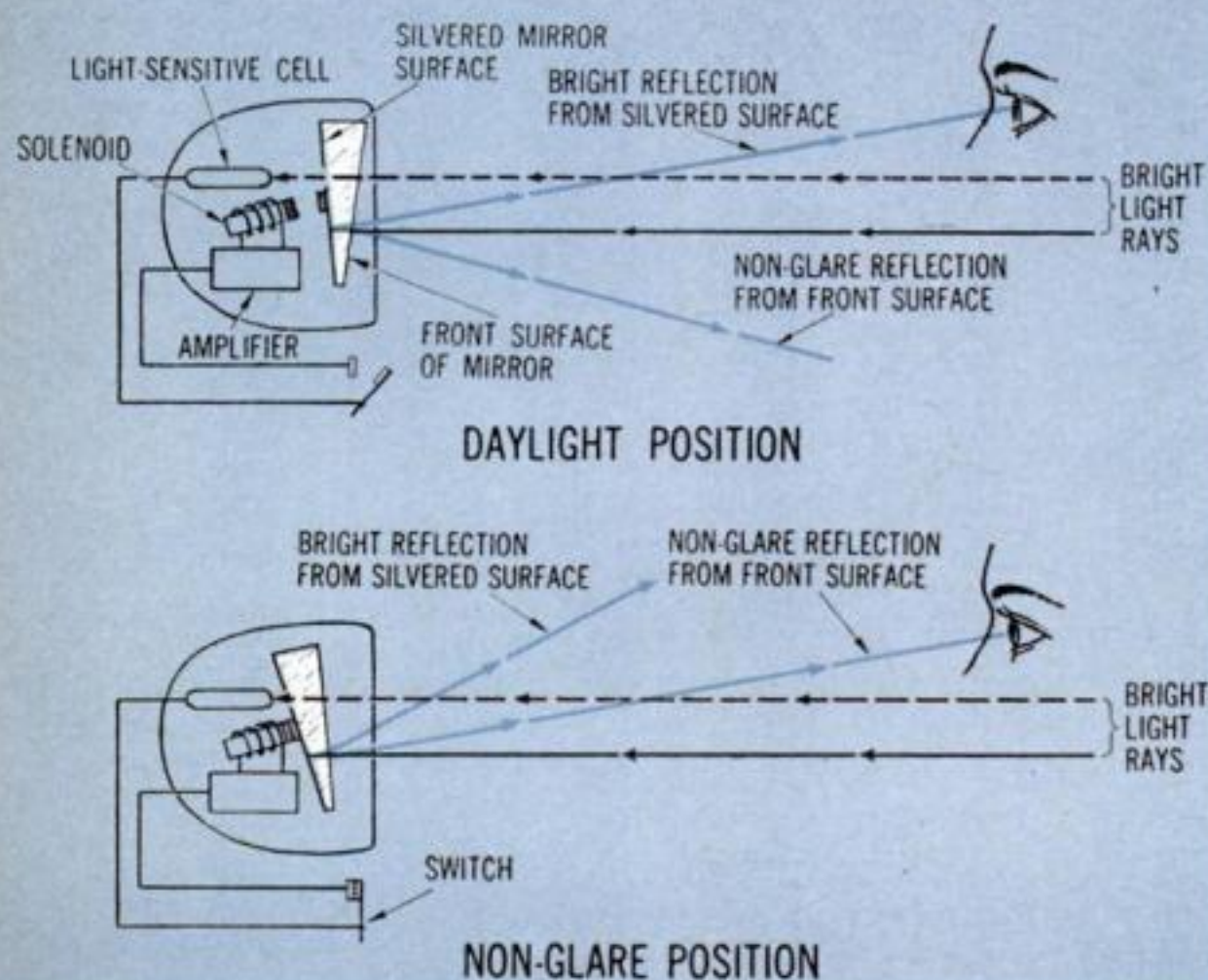
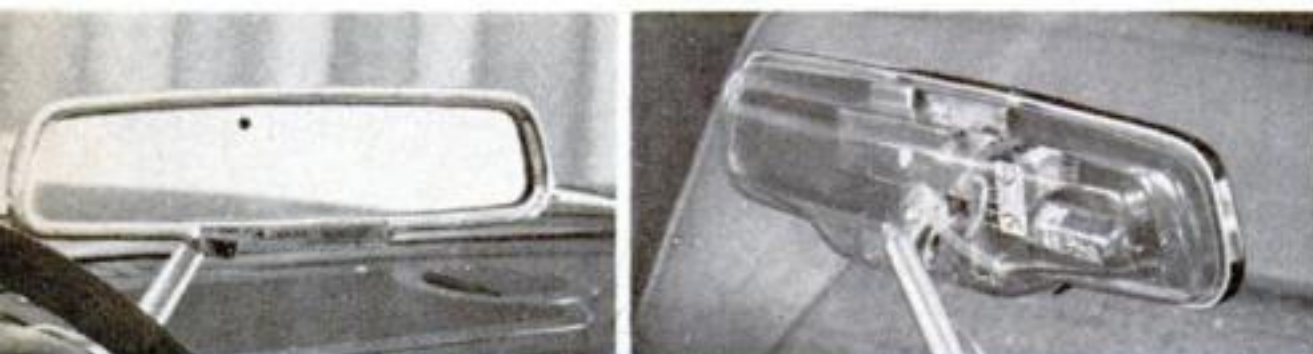
Swiveling front seats are the biggest new feature inside. As yet available only on higher-priced models, they restore

How the swivel seats work

A lift of a finger on catch near front corner of the swivel seat releases it from driving position. The occupant then swings seat over the sill. Stepping out is as easy as rising from a chair. Leg room is equal to that of regular seats. Head room, says Chrysler, is even better.



Electronic mirror dims glare from rear



A tiny hole in mirror backing (left-hand photo, top) admits light from following headlights to the photocell. Current from the cell, boosted by a vacuum tube, triggers a magnet that flips prismatic mirror to a non-glare angle. Three-way switch provides off position for daytime, sensitive setting for highway use, and a less responsive one for city driving.

some of the ease of entry so long sacrificed on Detroit's high altar of fashion.

At first glance they look like individual seats with an arm-rest between, but each swings outward as you lift a catch at the corner.

Swung out, the seats overhang the sill. You sit down almost before you get into the car. An easy body swing straightens the seat, the catch locks, and you're in.

Doors cannot be shut with the seats swung out, but a hand touch suffices to push them straight. The center back section, when raised, gives an in-between passenger back support.

Down, it forms a rest for the driver's right arm (and passenger's left), so welcome you wonder why you haven't missed it. The stationary underframe of the new seats can be fitted with either manual or power seat-adjustment. Fixed to this frame are a pivot bearing for each swing seat on the back edge and two roller studs in front, one near each outer corner.

At the back, each swing seat pivots on a bolt, with a nylon washer between bearing faces. Welded to the front is a curved channel U section turned with the open side facing forward. The channel rests on spherical nylon rollers that allow no wobble even when the seat is swiveled out.

Eye-catching new instrument panels, some in textured aluminum, now include bar speedometers and pushbutton controls for heating, ventilating and air conditioning.

In a cautious approach to oval steering wheels, long common in aircraft controls, Chrysler's are now flattened slightly at top and bottom. Too small for the eye to tell, the change makes for better over-the-rim visibility and lap clearance.

Surprising is an optional rear-view mirror wired to the car's electrical system. Inside the casing there's a photocell, a vacuum-tube amplifier, and a magnet. When bright lights sneak up behind, a magnet flips the prismatic mirror to kill glare.

You can get electronic headlight dimming, too. A photocell gauges light of oncoming headlights and taillights ahead of you, dips your beams if brightness exceeds a preset limit.

Car-by-car changes start with Plymouth, which changes its series names this year. Cheapest for '59 will be the Savoy, followed by the Belvedere, Fury and the new Sports Fury. You can still get all but the latter with the flathead six en-

gine and a manual, overdrive, or automatic transmission.

The 318-cu.-in., 9:1-compression Fury engine can be had in all models. So can a power-pack version with a four-barrel carburetor and dual exhausts or, topping the option list, the high-performance 361-cu.-in. Golden Commando engine introduced last year, now standard in the Sports Fury.

Plymouth's new instrument panel has the automatic drive buttons in a slanting line at the left (rather handier than they were on the dash) and the heater-vent controls in a similar line-up at the right.

Optional is a steering wheel with a translucent plastic rim and a single cross spoke. This is recessed between two lines of padding, a promising safety measure.

The Plymouth hood has a center rib. Tail fins that start forward of the rear window now cant outward slightly and taper to a narrow edge. Taillights are in wide horizontal housings. Optional is a rear deck lid with a simulated spare-wheel cover.

Dodge has a new face, too. The long straight trim line under the hood, which arched up into horizontal headlamp brows, has mutated into slanting brows that sweep downward inside. From the end of the fin down, there is now a reverse curve instead of the straight angle of '58. Leg room in the rear seat of a four-door Custom Royal hardtop I tried was good. Chrysler claims a gain of 3½ inches with a new roof panel having a shallow rise in the back plus a new door post.

De Soto styling changes start with an immense two-part bumper having a long air scoop between sections. Leg room in the four-door hardtop is improved by the Dodge roof, too.

Chrysler makes news with a fourth model—the Windsor X-3, to be made in red and white or red and black two-tone bodies only. This has a high-performance 383-cu.-in. engine with two four-barrel carbs.

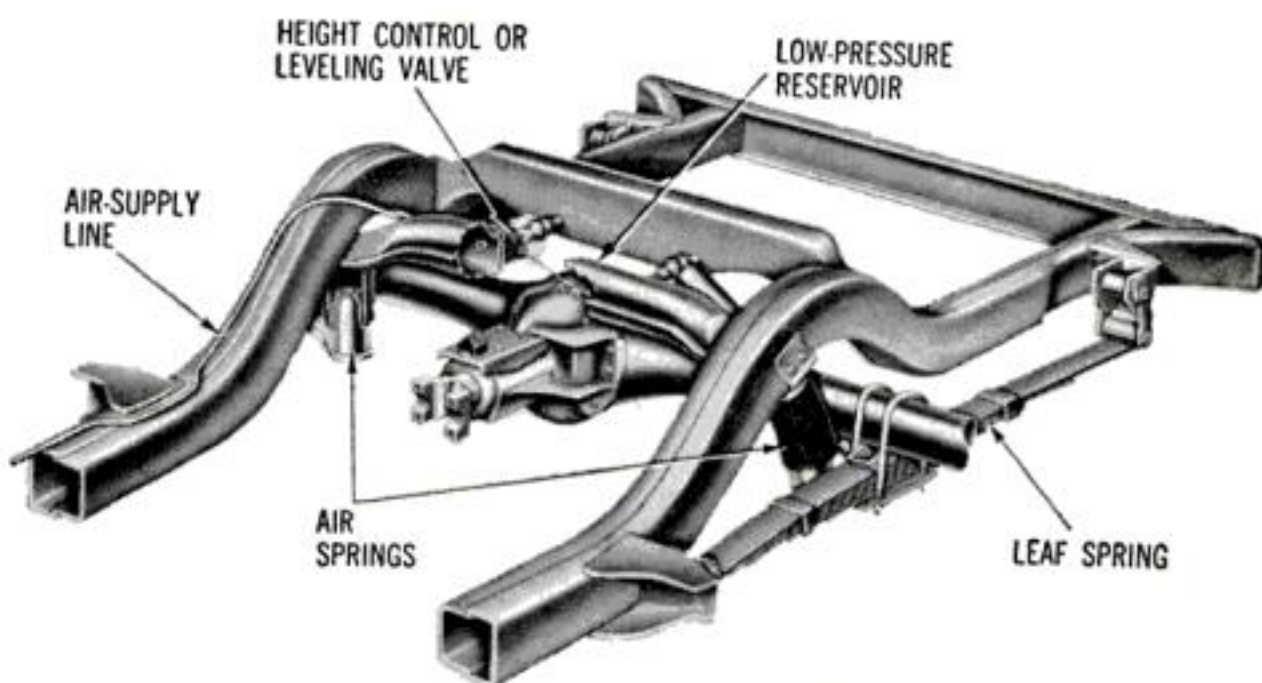
New Chrysler front ends have a heavier bumper, pronounced eyebrows and a textured grille. Two-tone roof finishes use a stainless-steel band running across the back and forward on both sides above the windows as the dividing line.

The New Yorker and 300E have the new 413-cu.-in. engine with one and two four-barrel carburetors respectively. The 300E is further souped up with special valve springs, camshaft and distributor.

Imperial's new grille has a heavy central horizontal bar with lighter ones above and below and five massive cross-pieces. Huge glass areas give the car a surprisingly airy appearance, and this year the side windows are curved. Roofs can be had with stainless-steel front areas, simulated-leather rear canopies or a combination.

A new frame raises the front seat three-fourths of an inch. The 413-cu.-in. engine with a four-barrel carburetor is standard and, as last year, so is a limited-slip differential. **END**

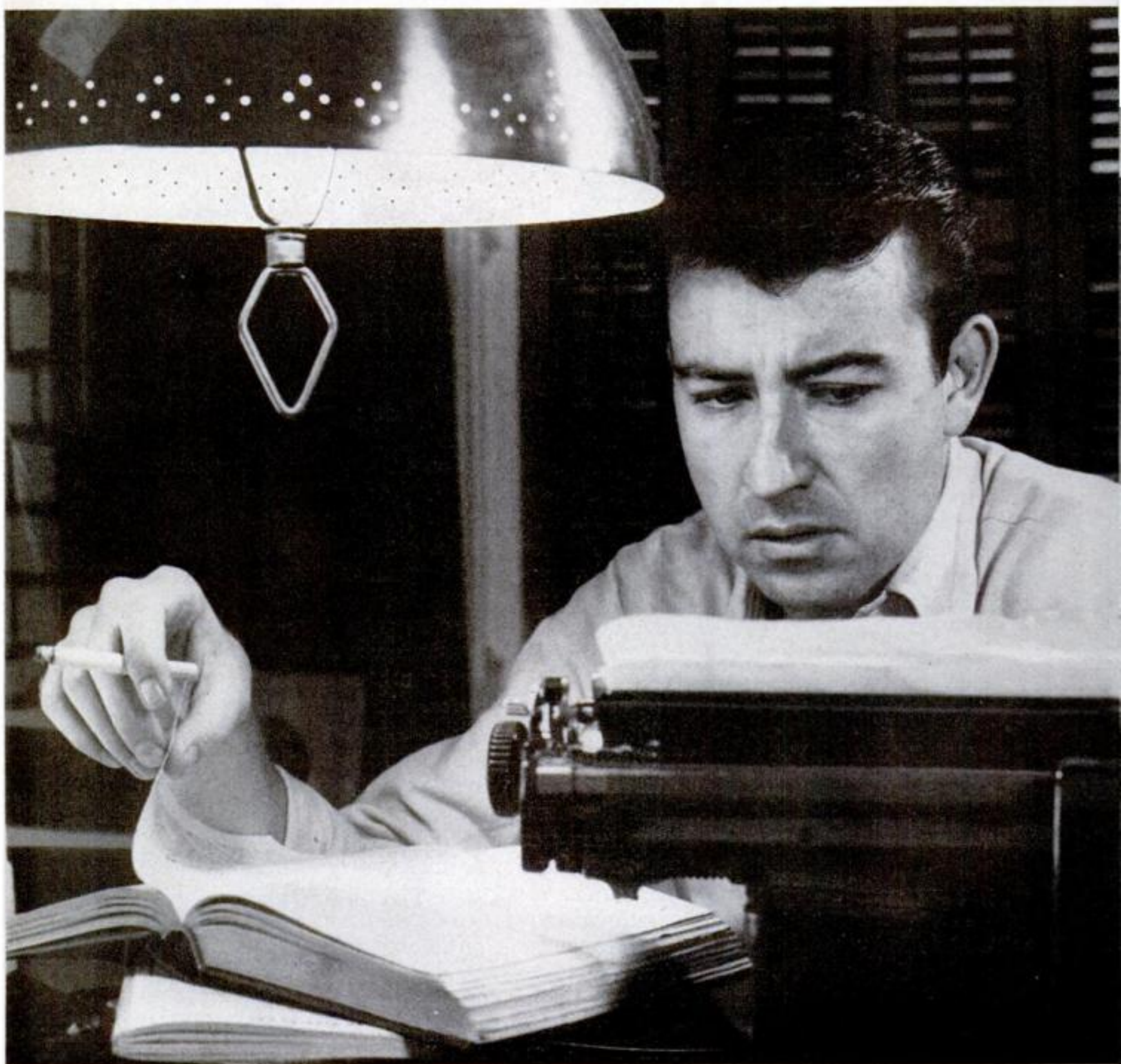
Airbags on rear are new option



Chrysler-line cars, coming around late to air suspension, will offer a combination steel-air ride on the rear only. The car can be driven on leaf springs if the air supply fails. System includes high-pressure compressor under the hood, air-storage tank at the front of the frame, low-pressure reservoir on the rear axle, two airbags, and a leveling valve.

THE SCIENCE OF PERSONAL SUCCESS

In a world of memos and reports, business correspondence, sales letters, and job applications, you need writing skill to clear your path to promotion. The three fundamentals are easy to learn



How to Put Your Good Ideas on Paper

By Max Gunther

SAMUEL JOHNSON, literary giant of the 18th century, listened morosely one day while a merchant grumbled about the amount of letter-writing required in his business. "It strikes me as unfair," the merchant said, "that we men of business must know how to write, while you writers need know nothing of business."

"Sir," bellowed Johnson, "you may be a king or a chimneysweep, but if you cannot write, you are nobody."

As usual, Johnson exaggerated. In those days, relatively few people ever got more than a grade-school education, and even successful businessmen were sometimes illiterate. But if Johnson made the same statement today, he'd hardly exaggerate at all.

Almost everybody, no matter what his job, is expected to have some writing ability. To a very real extent, in fact, your success in today's world depends on your ability to sound good on paper.

When you're applying for a new job, for instance, you may write a letter and an outline of your past experience. The man to whom you send this material has never met you or heard of you before; he has nothing to go by but what you've written. If it fails to interest him or clearly get your message across to him—or if it gives him an impression of sloppiness, stodginess or coldness—you're out of the running. The same thing happens

when you write up an idea for the suggestion box, or try to sell something by letter, or ask for information.

Or take reports. Big businesses in recent years have become especially fond of reports as a way of keeping in touch with far-flung operations. Companies such as Esso Standard Oil and International Business Machines spend a good deal of money to teach report-writing to employees—all employees, from executives to nonsupervisory people.

Even if you haven't written a report yet, you'll almost certainly have to start at some stage of your climb to bigger jobs. The reports you turn out will be passed along and read with care. Your immediate boss knows your work, but how about the men above him? They may have no better clues to how good a job you're doing, or what kind of man you are, than what they find in your reports. If the fellow next to you writes better reports than yours—if he makes himself sound more intelligent, more forceful, more decisive—he may get the next big promotion instead of you.

Can you beat him at this game? Yes, and without too much trouble. "Assuming that a man has retained the elementary rules of grammar, spelling and composition that he learned in school," says Harold Schmidhauser of the American Management Association, "he needs only a little extra guidance to make him an effective writer." Companies of all sizes send employees to learn writing skills

from Schmidhauser. His course takes only two weeks.

If you have the time, you can sign up for a night course in writing at a nearby university or adult-education program. Or you can do your studying at the library. You'll find guidance in such books as Robert Gunning's *Technique of Clear Writing*, J. H. Menning's and C. W. Wilkinson's *Writing Business Letters*, Leland Brown's *Effective Business Report Writing*.

Robert S. Mason, chief of the New York Life Insurance Company's program for teaching writing skills, suggests still another idea: After reading a few textbooks on the subject, get together with some career-minded friends and set up a writing-workshop group. Bring copies of your letters and reports to the meetings, and let criticism flow freely.

What you'll learn, no matter how you go about it, is that all good writing has three main ingredients. Whether it's a Pulitzer Prize novel or a sales letter, it has clarity, force and personality. Here's what these three mean:

Clarity

A manual published by New York Life contains a copy of a letter actually sent to a policyholder a few years ago:

Dear Mr. Blane:

Surrender of the policy is permissible only within the days attendant the grace period on compliance with the citation relevant options accruing

to the policy so we are estopped from acquiescing to a surrender prior to the policy's anniversary date.

It squirmed on for some distance more. Blane's reply:

Dear Mister:

I'm sorry, but I don't understand your letter. If you will explain what you mean, I will try to do what you ask.

The insurance company's letter broke the three main rules of clarity. Blane's reply observed them all:

● **Be brief.** Say what you have to say, then button up. Make it just long enough to get all your ideas in and to avoid being curt. Don't worry if you end up with only two lines in the middle of a big, white sheet of paper. It may not look ideal esthetically, but it'll delight the busy man you send it to.

● **Use short words and sentences.** Consultant Robert Gunning has worked out what he calls a "Fog Index" by which you can measure how difficult your next letter or report is to read: First, count the number of words in it and divide by the number of sentences. This will give you the average sentence length. Second, count the number of words having three syllables or more (but don't count proper names, combinations of short words such as "dishwasher," or verbs that are expanded to three syllables by endings like *-es* and *-ing*, as in "trespassing.") Finally, add those two figures and multi-

[Continued on page 248]

Six Tricks for Livelier Letters

THE experts suggest these gimmicks for putting extra punch into your writing. Remember, though: Don't overdo them or they'll lose their potency—especially if you use them on the same man.

1. Where you want emphasis, use a question-and-answer technique instead of a flat statement: "How much will this cost? Nothing."

2. Once in a while, prod your reader wide awake with a one- or two-word paragraph: "It worked." "They bought it." "But:"

3. Use asterisks or numerals to separate parts of a series: "The machine needs replacing for six reasons:

*It's too low-powered for the work we want to do.

*It drinks three quarts of oil a day..."

4. To drive home a point, use a well-known quotation—and name its author (you'll find him in Bartlett's *Familiar Quotations*). Like this: "As Kipling said, 'For all we take we must pay, but the price is cruel high.'" But remember: Use this trick sparingly; it's one of the easiest to overdo.

5. If there's something you particularly want to emphasize in a letter, scrawl it in ink as a postscript beneath the main, type-written portion of the letter. It needn't be an afterthought, but can be built solidly into the letter's strategy.

6. Use the recipient's name once—and only once—in the body of the letter, wherever you want him to read with extra attention: "Despite all the disadvantages, Mr. Jones, the plan looks good to us..." If you use his name more than once, though, you'll give your letter an unpleasant apple-polishing tone.

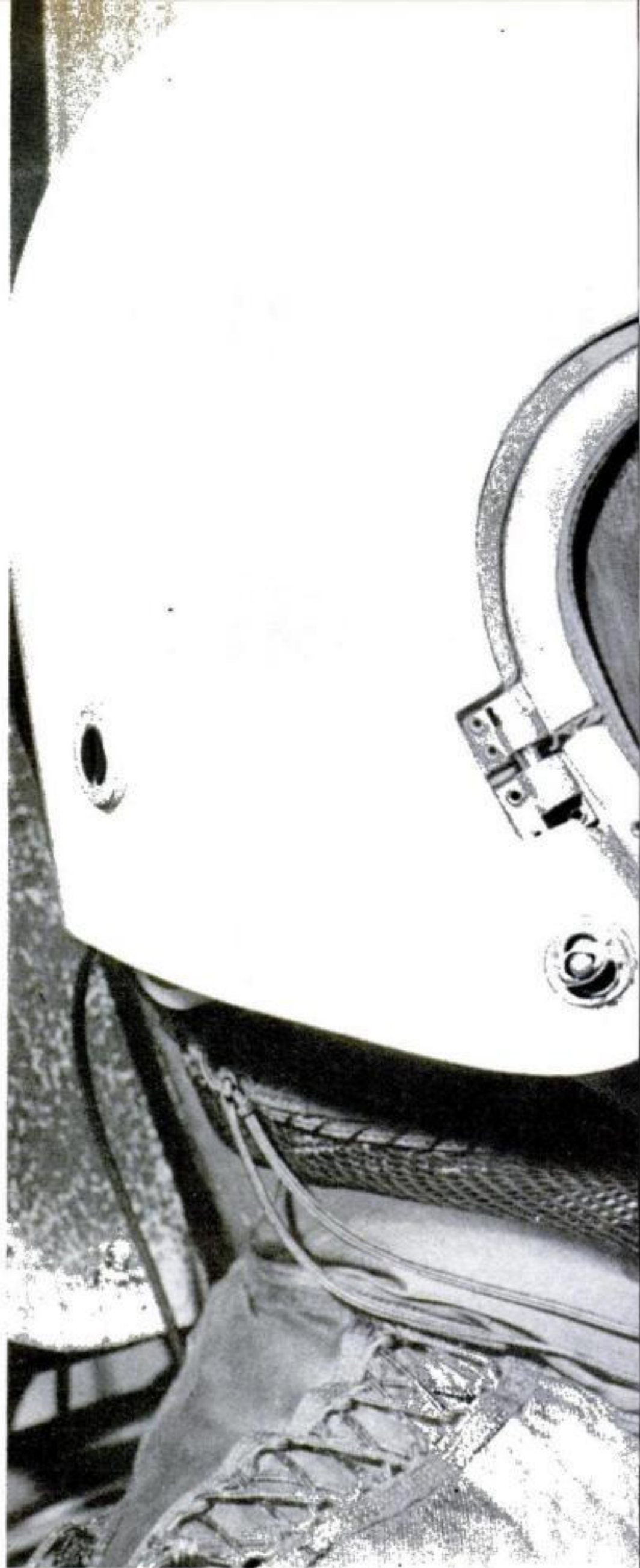
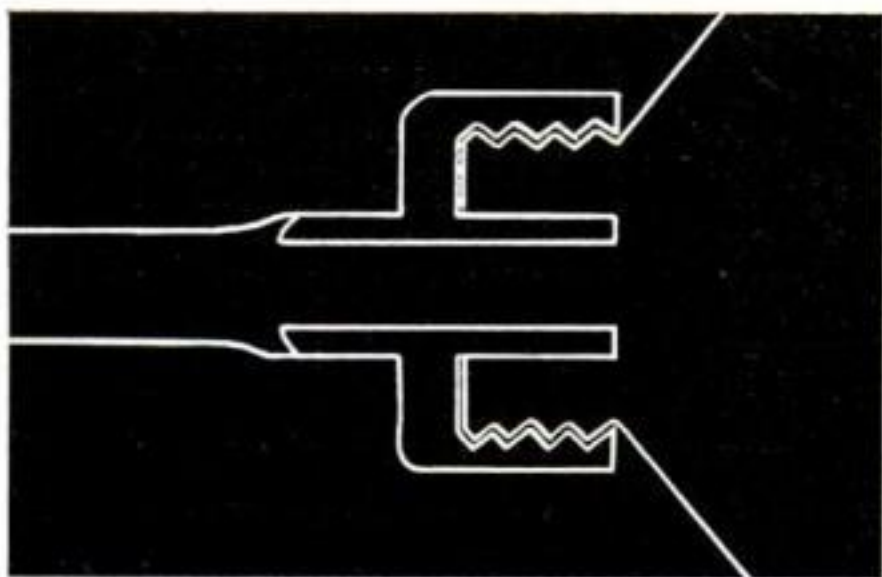
Letter-Killers

THE New York Life Insurance Company, which mails out almost a million personally signed letters a year, has compiled a list of phrases (left) that will give your letters the appeal of a wet sponge. Suggested substitutes are on the right.

DON'T SAY

DO SAY

acknowledge receipt of	received; got
yours of the 15th inst.	your letter of May 15th
as per your request	as you asked
at an early date	soon
at this writing	now
attached (or enclosed) please find	here's
beg to advise that	(forget it altogether)
beg to remain	(forget it altogether)
deem	think; believe; guess
has come to hand	came; arrived; got here
I have before me	I've received; I've read
I trust	I hope; I'm sure
in re; in reference to; as regards; in connection with; in regard to	about; on; as for
(a check) in the amount of	for
kindly	please
meets your approval	is all right; is what you wanted
please note	you'll notice; you'll see
you may rest assured	you can be sure; I can promise
same (used as a pronoun)	it; your letter; the money
pursuant to our conversation	as I said; as we agreed
regret to advise	I'm sorry to say; unfortunately
am pleased to advise	I'm happy to say
the said (or aforementioned) tools	the tools; the tools you asked for
take the liberty of	(forget it altogether)
thanking you in advance	(forget it altogether)
the writer; the undersigned	I; me
under separate cover	in another envelope
with your kind permission	if it's all right with you
would advise (state, inform) that	(forget it altogether)
I am; I remain (winding up for the close)	(forget it altogether)
yours kindly; yours with regard to above; yours most sincerely; very truly yours	yours; yours sincerely; sincerely; best regards

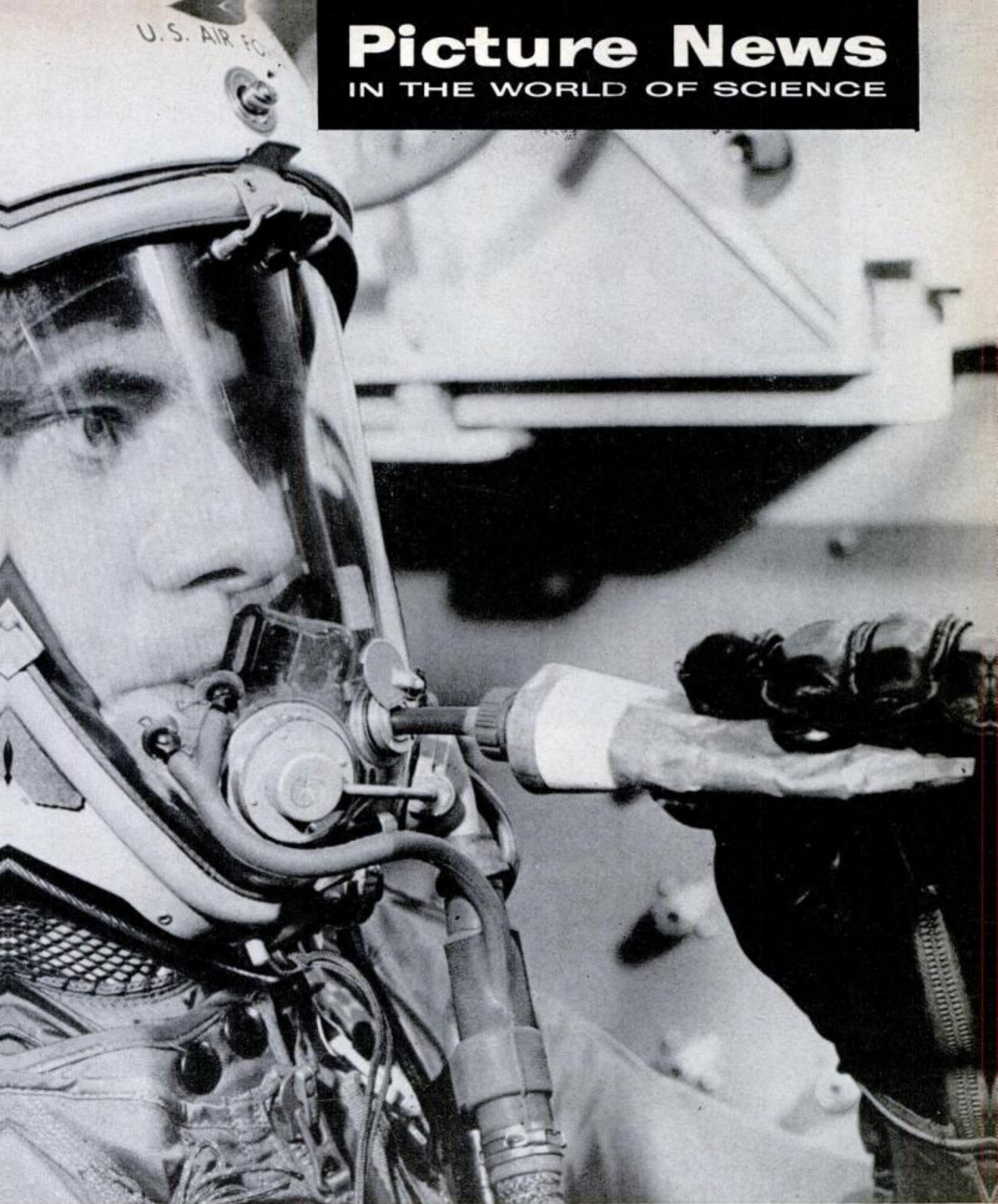


Space meal in a toothpaste tube. Lunchtime in a space suit used to depend on gravity's bringing canned food down a tube (bottom left) through a helmet—where the pressure, sometimes higher than outside, might blow the food right out again. A new method is shown being tested here: Pick your flavor, then serve yourself from an aluminum tube. American Can is making 3,000 of the tubes for use at Wright Air

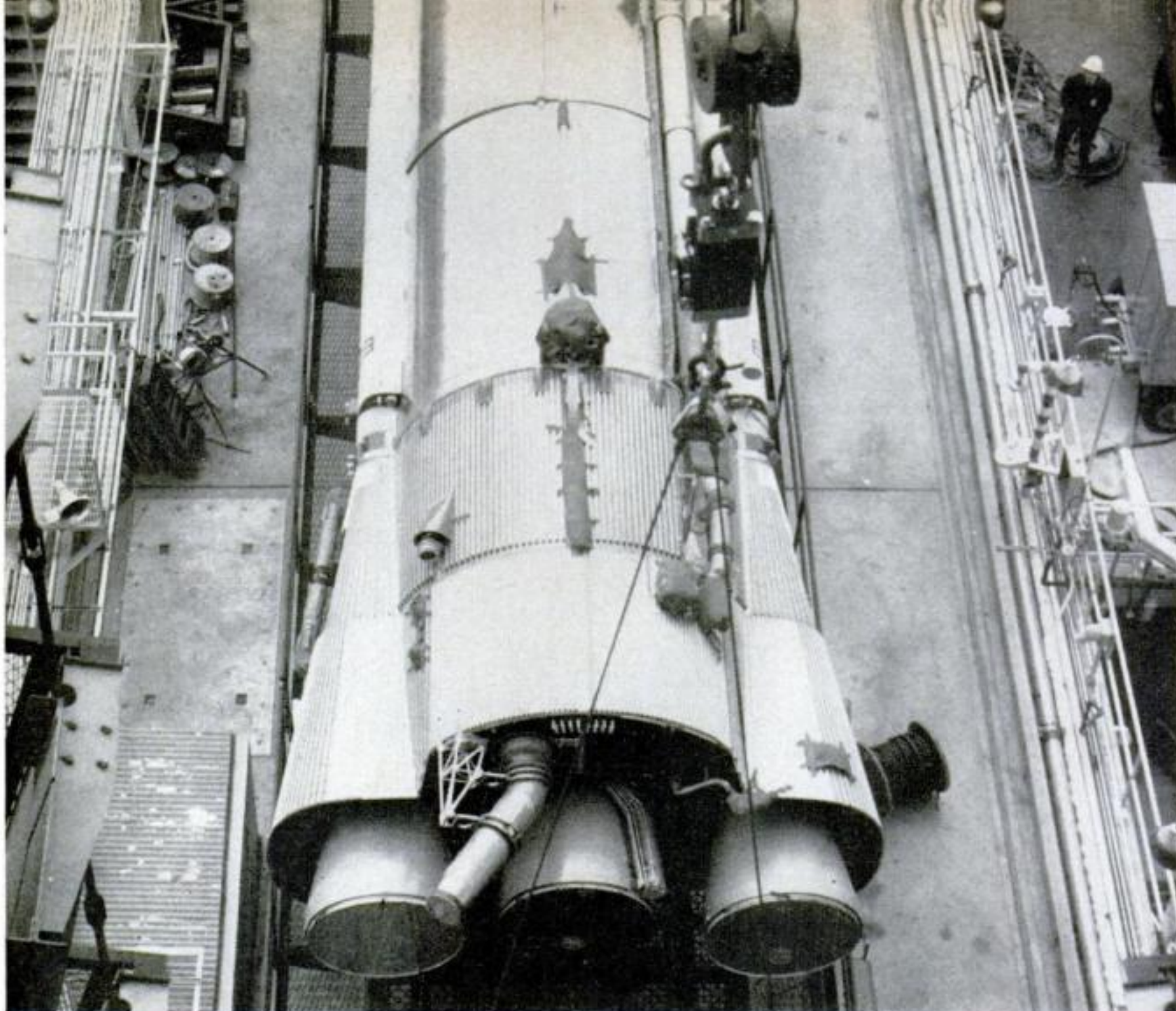
U. S. AIR FORCE

Picture News

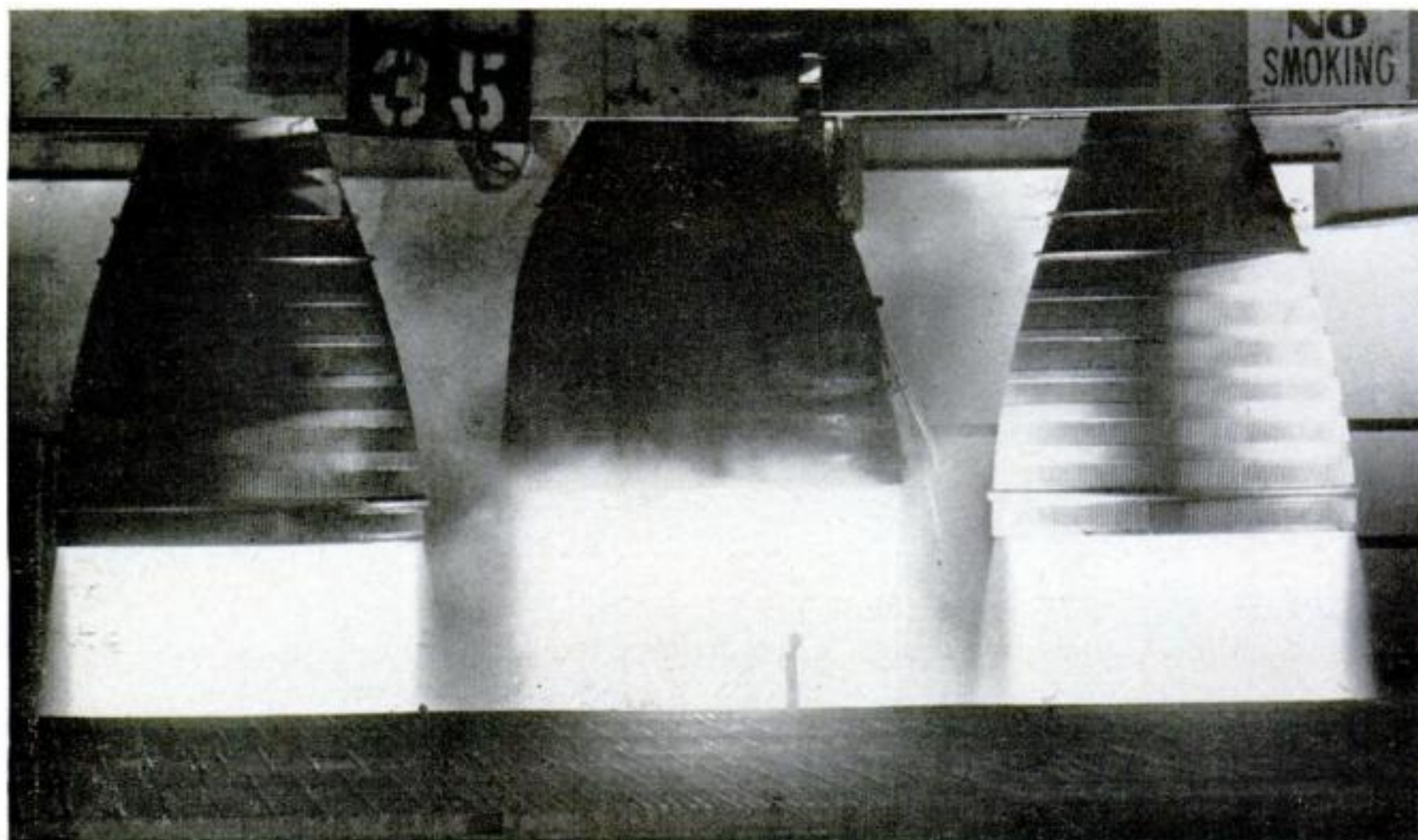
IN THE WORLD OF SCIENCE



Development Center. There's a choice of 12 semisolid (ham, beef, chicken) and liquid (chocolate- and coffee-flavored milk) lunches. The spaceman, in an altitude chamber simulating a 40,000-foot elevation, fits a plastic nozzle to the tube, screws it on tight to cut an opening (top left and middle), pushes it through a valve in the faceplate of his helmet and into his mouth. To eat, he merely squeezes the tube.

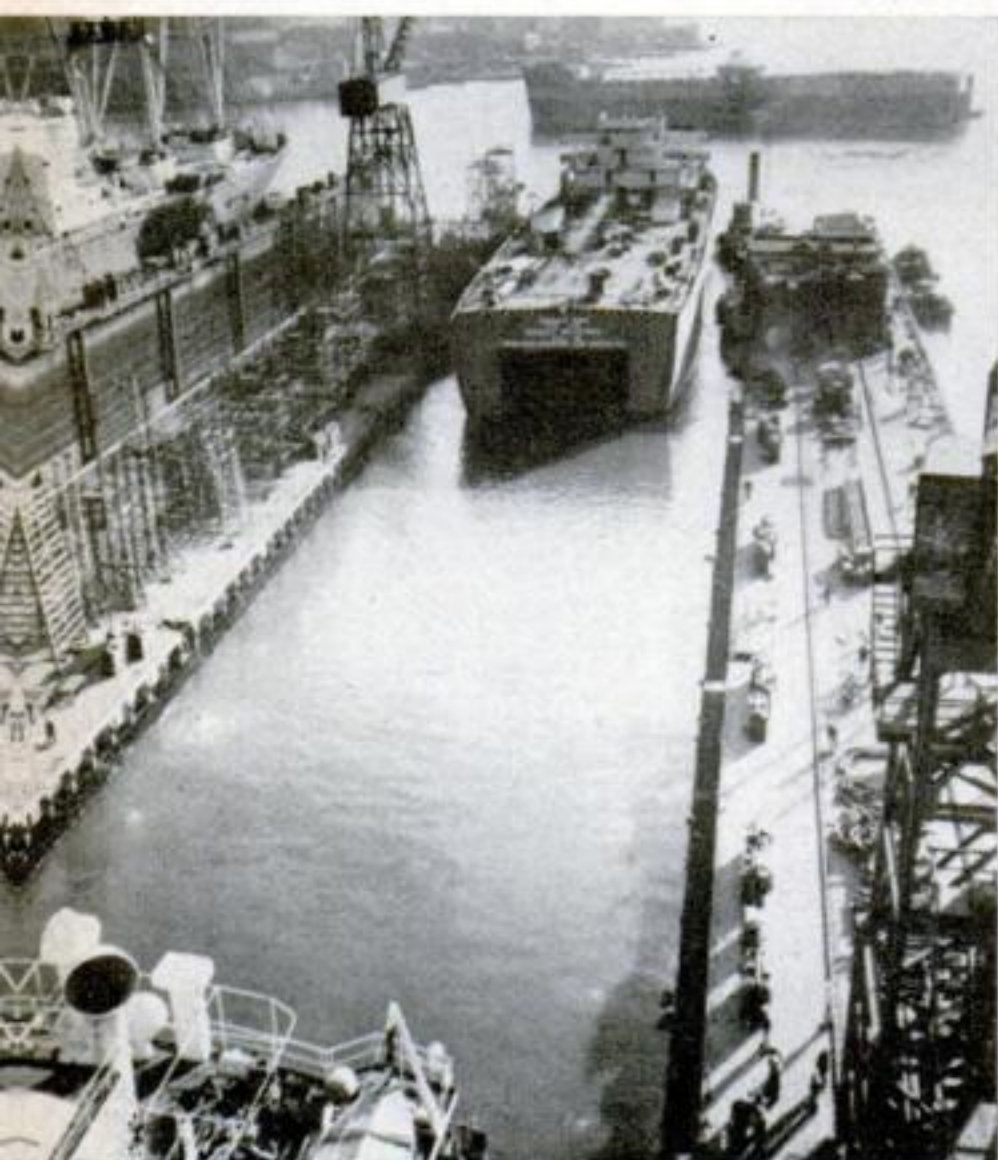
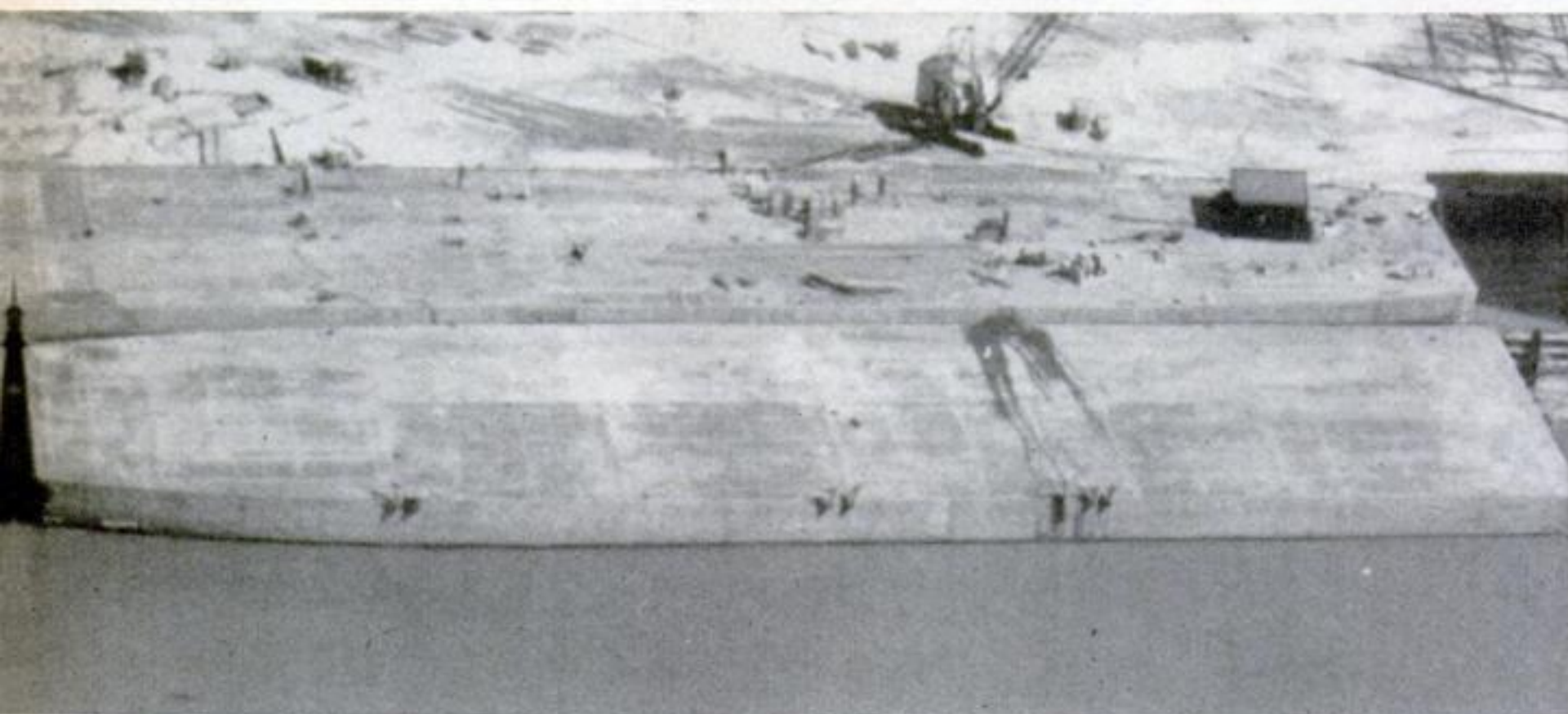
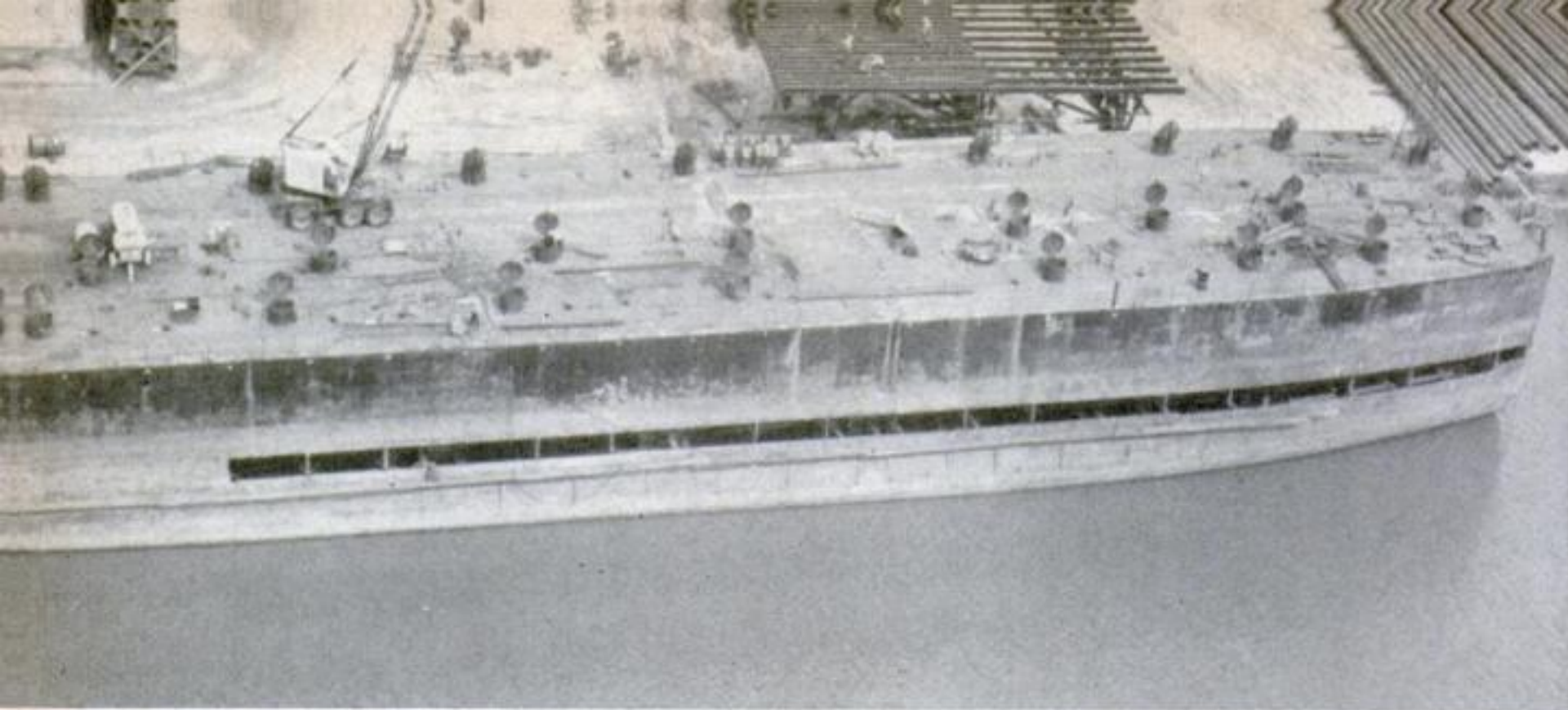


Atlas gets full power. Close-up above shows recently added third engine —between two boosters—which extends the reach of the 80-foot ICBM to 6,000 miles. Successfully fired at Cape Canaveral, Fla., the new engine sustains the missile in long-range flight after the boosters drop off. Below: distortion of center chamber during full-power test firing.





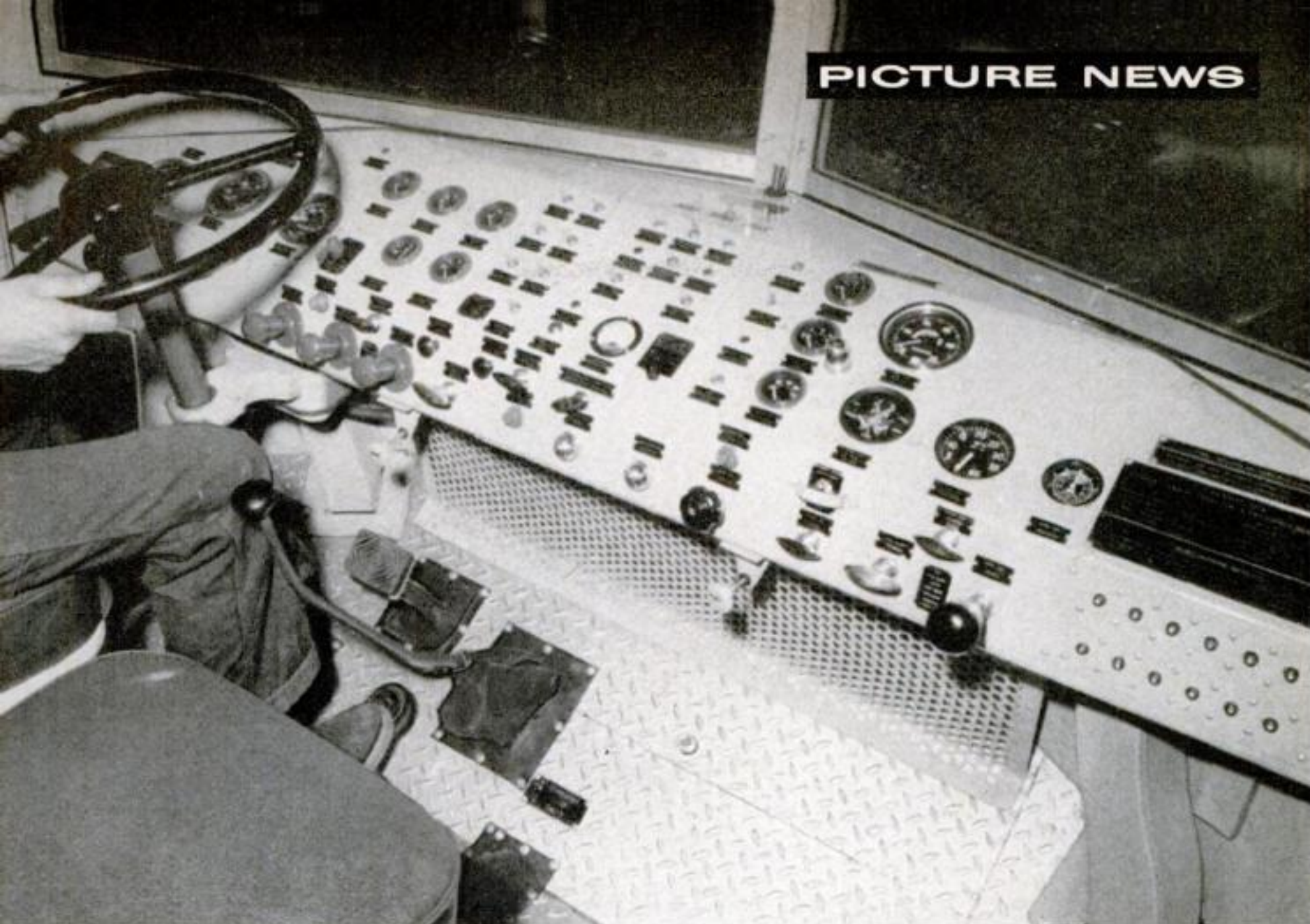
Walking a copter. Holding a copter at the end of a 50-foot leash, the man above can lead it around like an obedient dog. An electronic device senses his wishes: The ship follows if he tugs on the cable, dips if he reels in, rises if he slacks off. Among the uses of the Sikorsky system: picking up cargo slings, landing in blackouts.



Saved from scrap pile. The obsolete midsections of old oil tankers—cut out by ship surgery and replaced by larger, modern midsections—are going to sea once again. At J. Ray McDermott's plant at Morgan City, La., they split the old midsections horizontally—like opening a clam—and turn them into two barges, from the top and bottom halves.

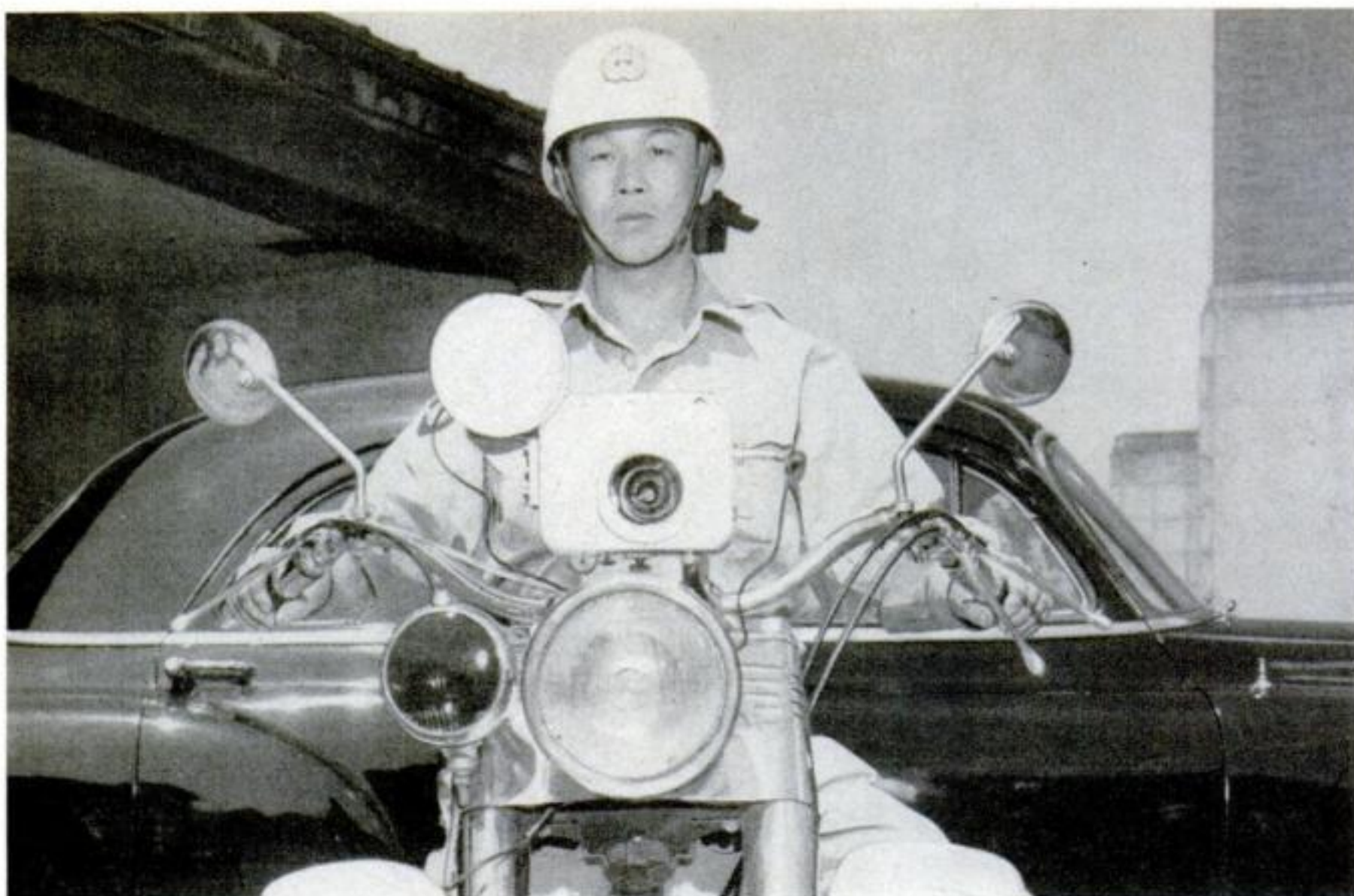
McDermott bought several old middles, stripped off steel plates down the centerline along the sides (top photo) and put in new decks—one on top of the lower half, one on the bottom of the upper half. Then a new hull bottom was built *atop* the upper section in place of the old deck, the joining members were cut apart and the upper section was flipped over by a giant derrick.

The middles (an unconverted one is shown at left) are from T-2's that were "jumboized" by oil companies to increase their capacity [PS, June '57].

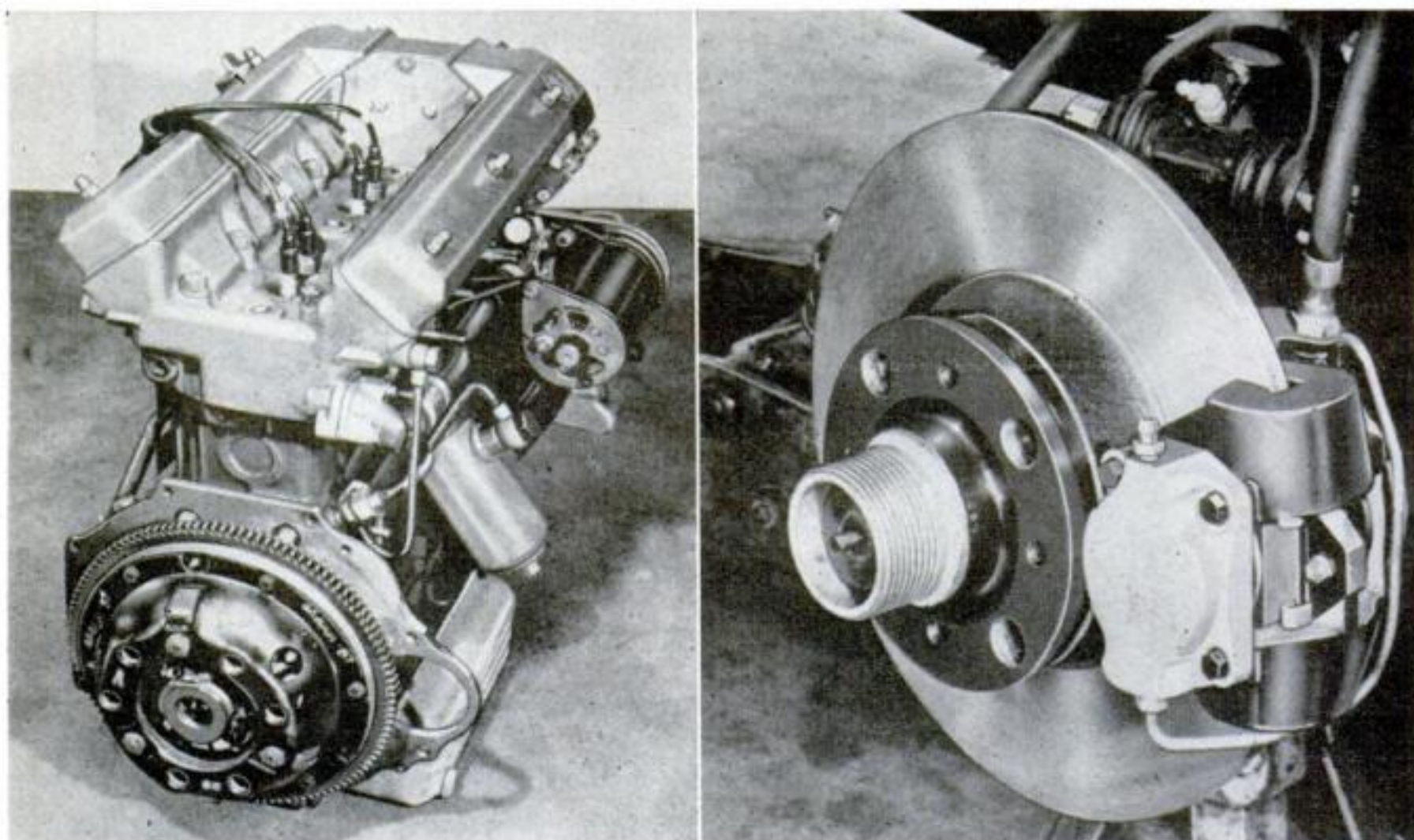


Fingertip firefighting. A dashboard as complex as an aircraft instrument panel puts the driver of this new American LaFrance fire engine in charge of operations without leaving the wheel. In use at U. S. Air Force bases, it controls everything from water-fog and air-foam nozzles to pumps, floodlight and engine. At lower left, a crew member aims a hand hose. Right: turret nozzle (on cab) and ground-sweep nozzles.

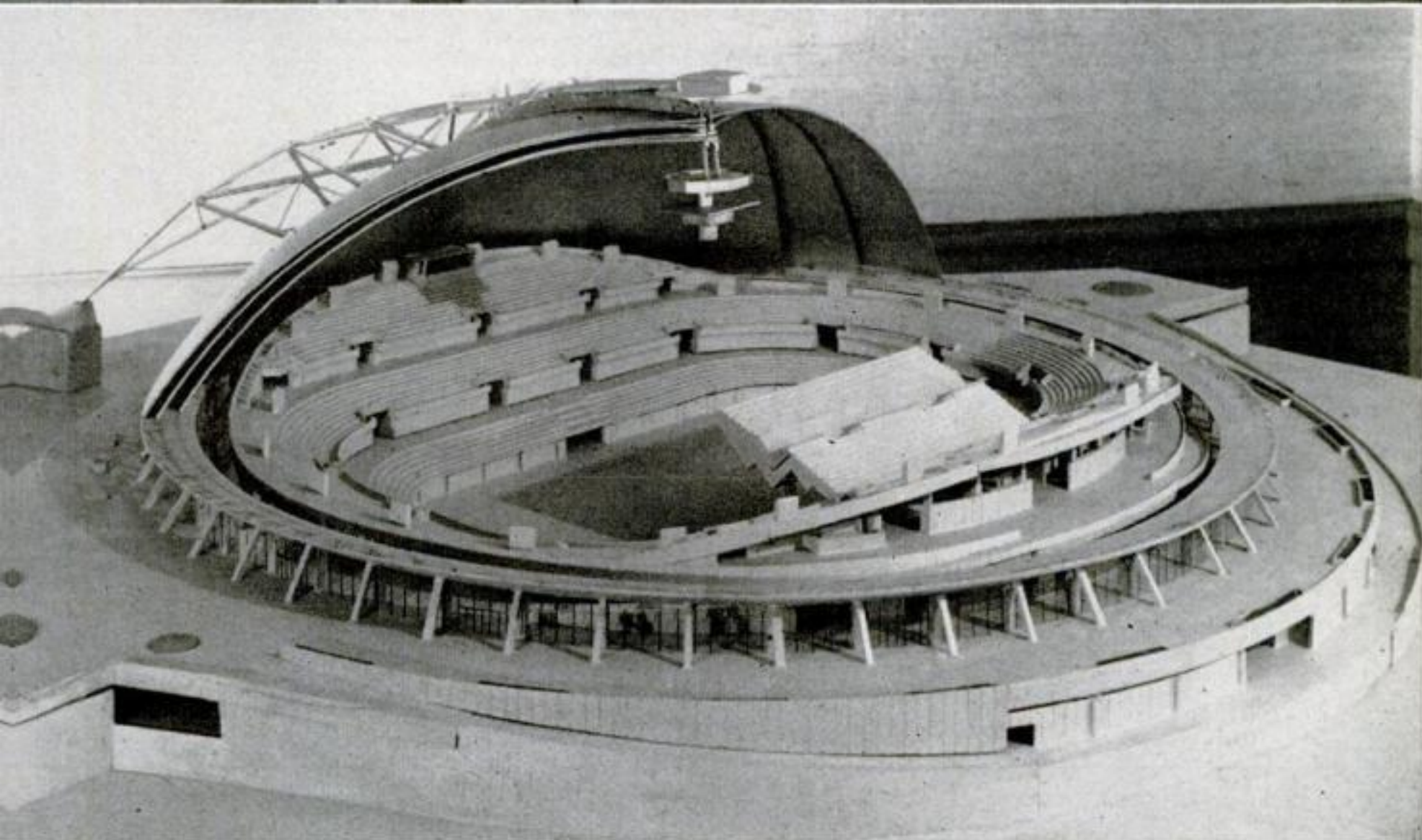
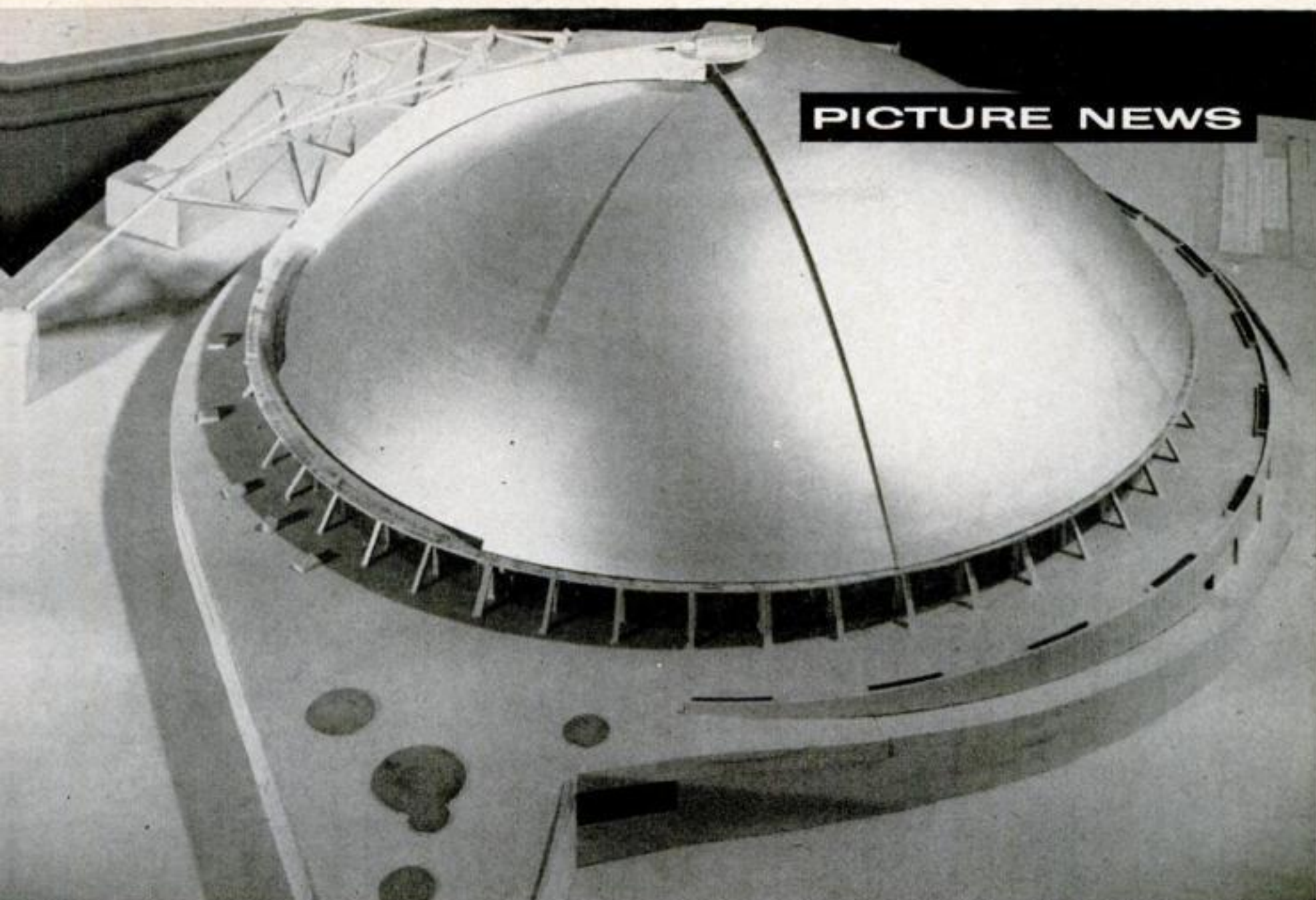




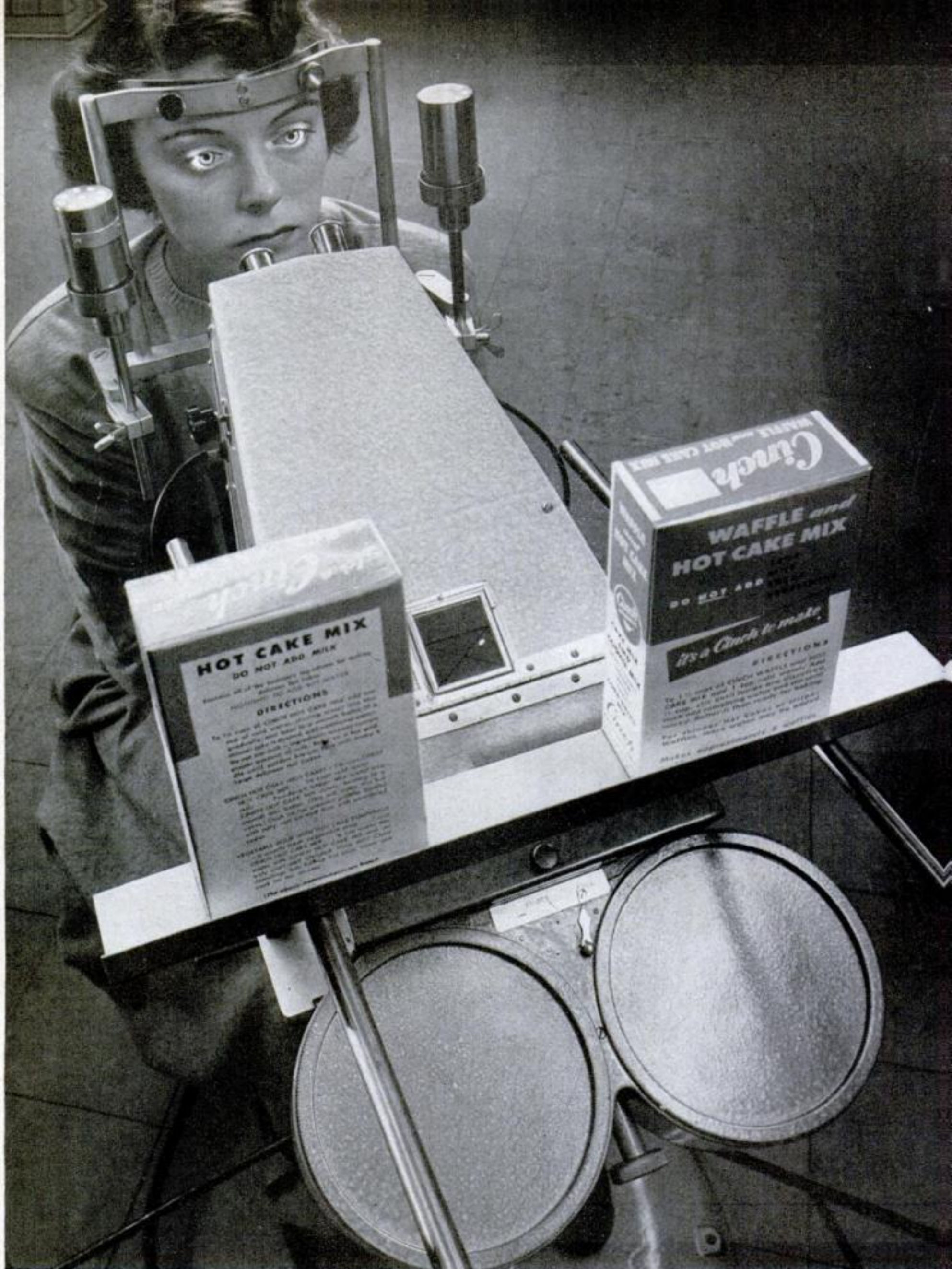
Handlebar camera. With a 35-mm. camera and flash mounted on the front of their motorcycles, traffic cops in Tokyo are ready at all times to get photographic proof of violations. A button on the handlebar works shutter and flash, starts a motor that advances the film to a new frame.



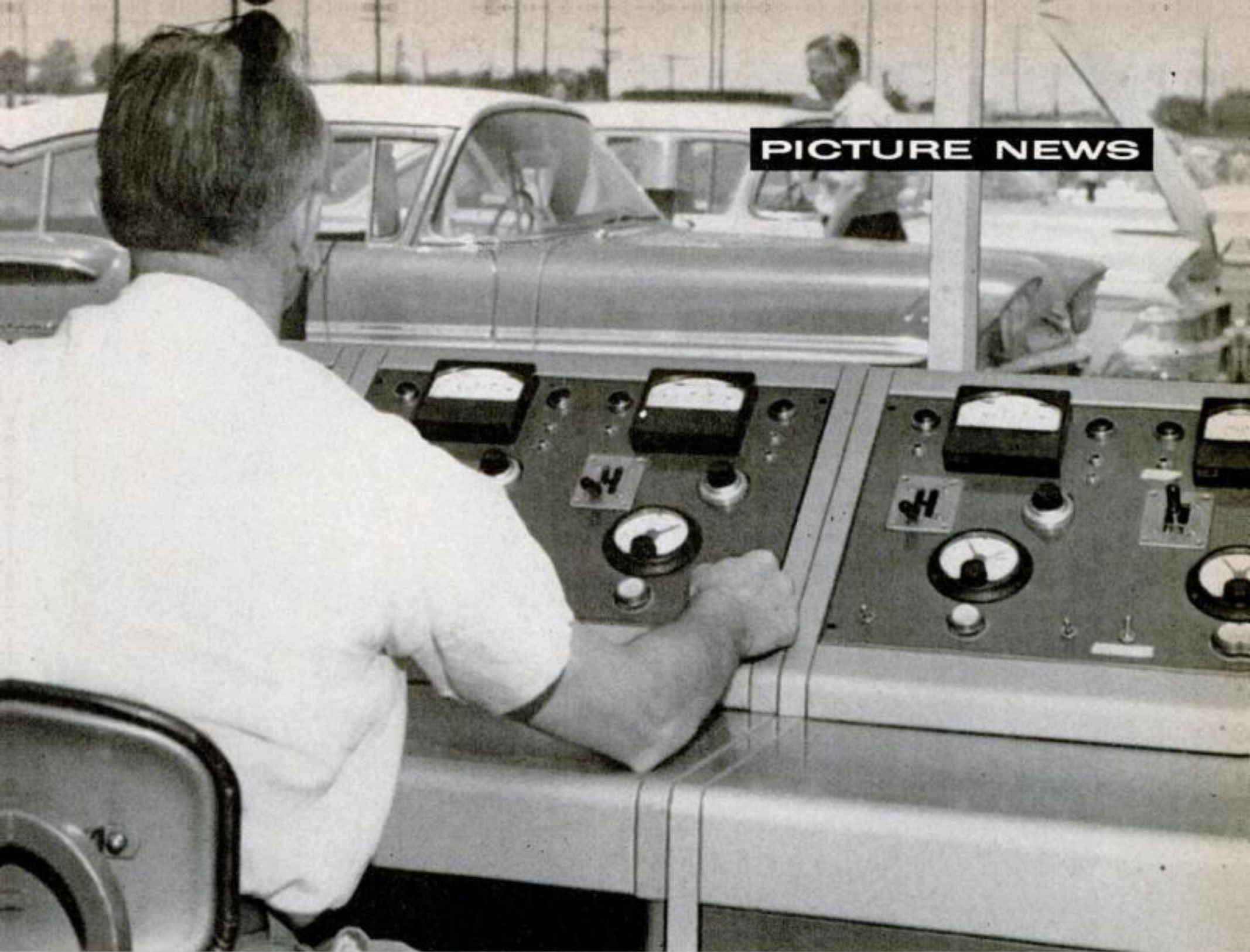
Twin camshafts. Two sets of overhead cams over four in-line cylinders pep up the new MGA, giving it racing-car performance. The two camshafts (above left) form arms of a V with the cylinders at the point. The British makers claim acceleration from zero to 110 m.p.h. in 38 seconds. The "Twin Cam" MGA also has disk brakes (right) on all wheels.



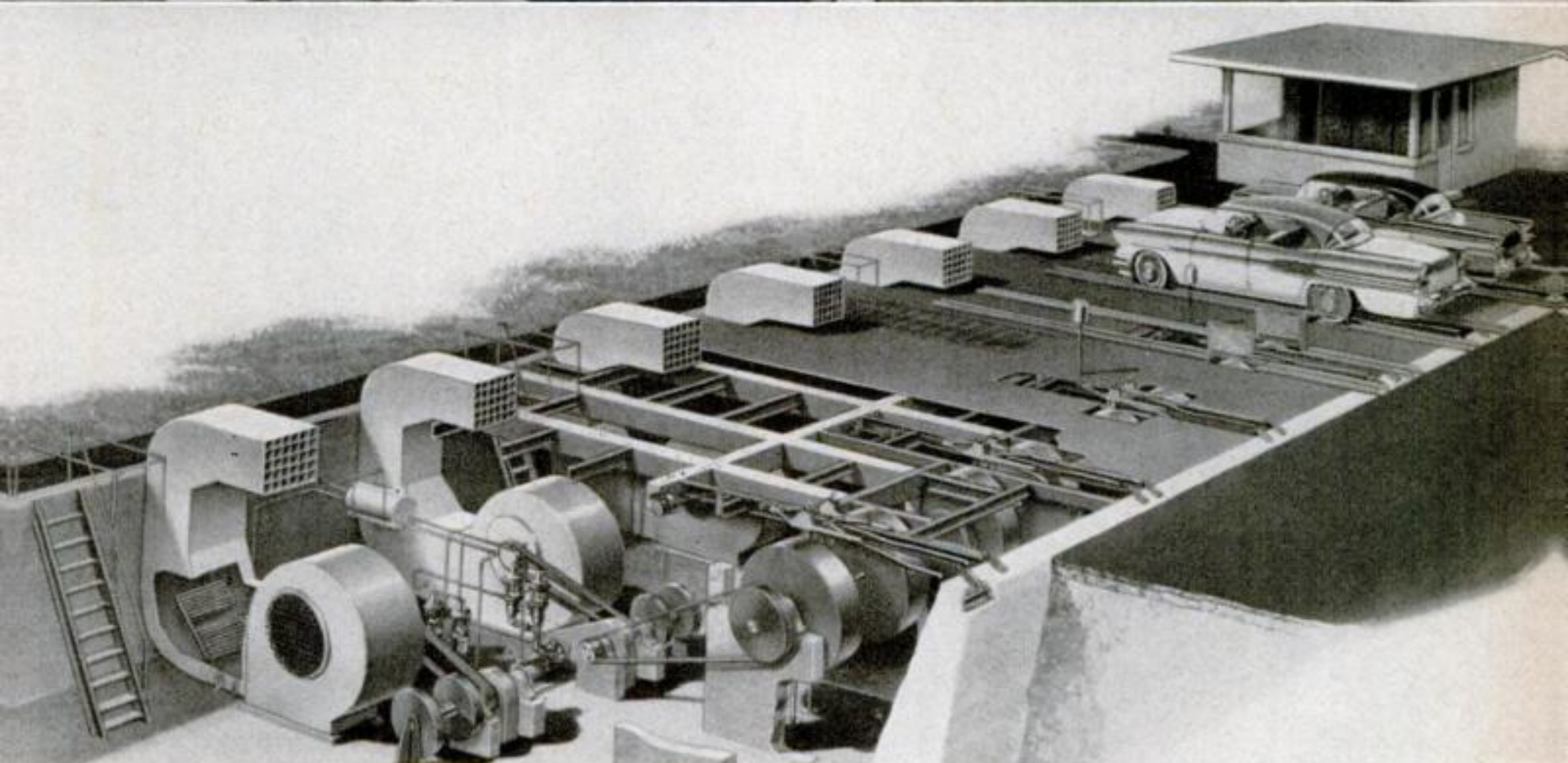
Under the stars, or out of the rain. When this retractable roof—first of its kind in the world—goes into operation on the Pittsburgh Civic Arena in 1960, patrons will enjoy indoor or outdoor entertainment. The 415-foot-diameter stainless-steel dome will be built of eight big panels, two stationary and six movable on two sets of circular tracks.



Girl with luminous eyes. This pretty model is being photographed—but nothing but her eyes will be seen. She is posing in front of an ocular camera, used by the Container Corporation of America to test the “eye appeal” of new packages. It takes a sequence of shots showing where the eyes, spotlighted from both sides, look for features in the design.



PICTURE NEWS



Auto automation. Tape recordings, made during on-the-road runs, control the acceleration and braking cycle of these cars testing new gasolines and lubricants on treadmills at the Esso Research Center in Linden, N. J. Rear wheels rotate drums, belted to inertia disks and fans in the pit (in cutaway), which absorb power a car would use on the road.

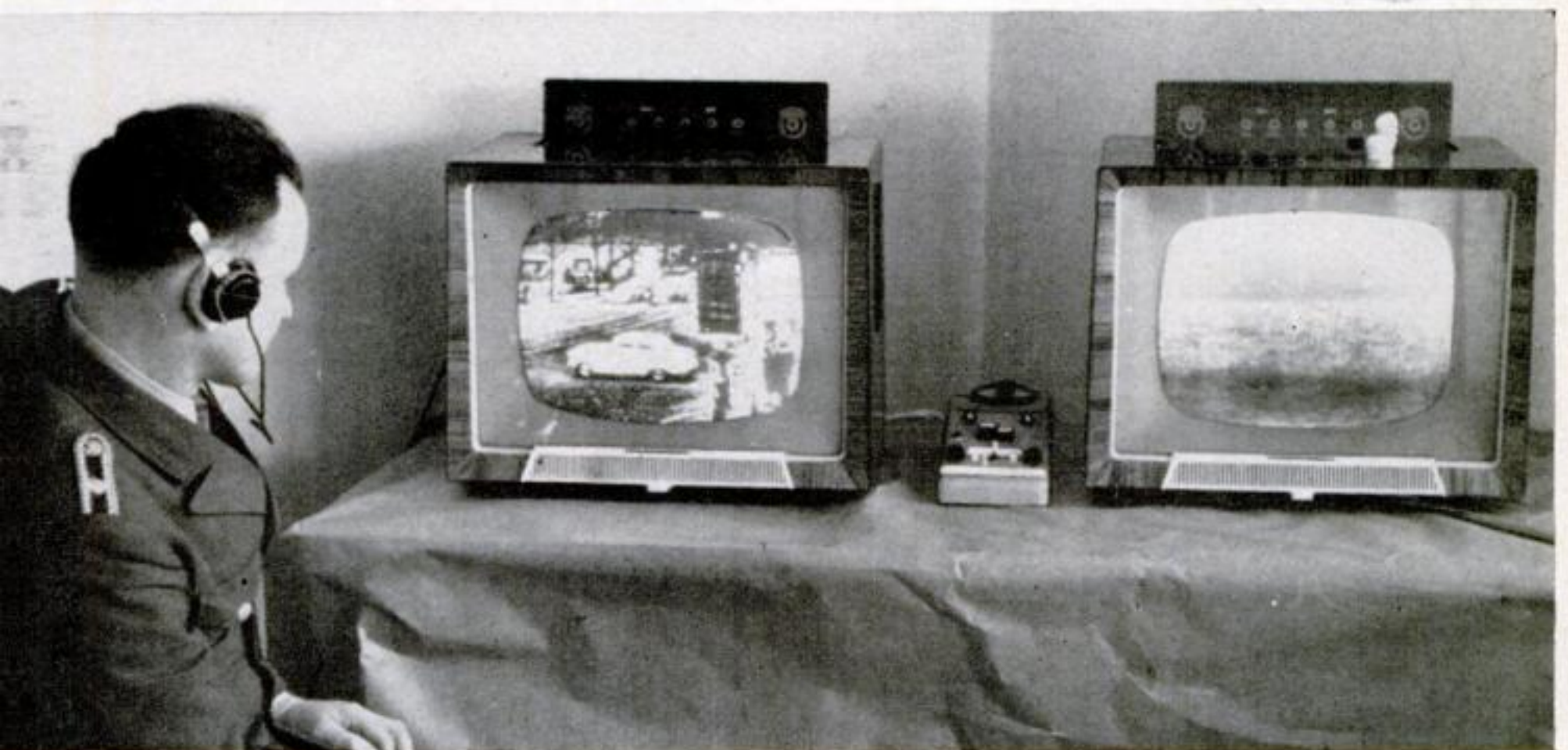


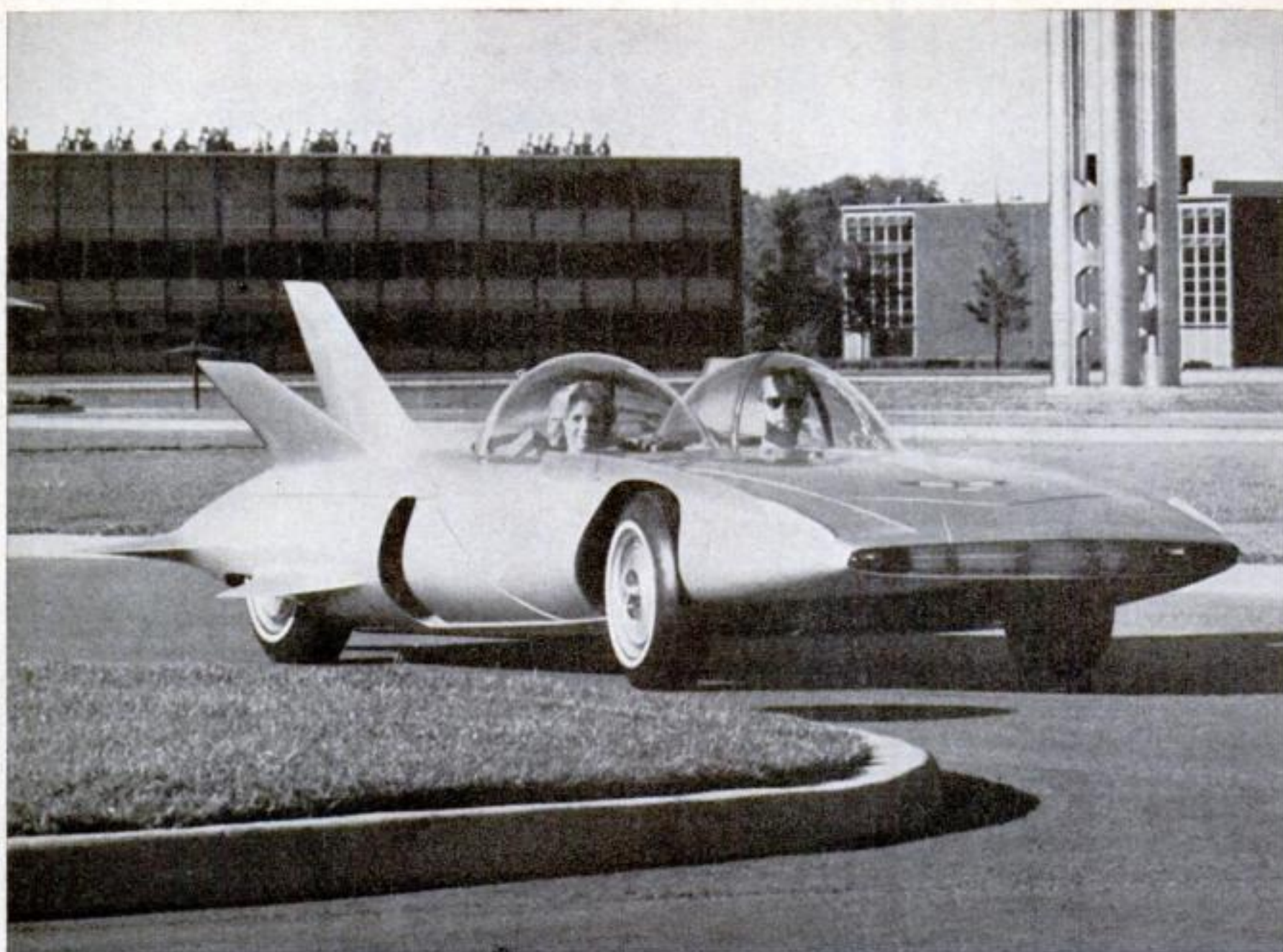
Traffic speed-up. New roads and expressways are only part of the way Europe keeps cars rolling in periods of unusually heavy traffic. Here is how the police of Hanover handle 40,000 vehicles morning and evening during the summer season of German fairs and exhibitions.

Left, top to bottom: All major and many minor roads are one way in peak hours, reversed for the return, and equipped with pedestrian crossings. Ramps at side of steps help in trundling motor bikes. Control towers are spotted at intersections.

Police with walkie-talkies and helicopters (above) watch over one of four huge parking lots to prevent jams. TV receivers at headquarters (right) provide trouble shooters with a view of "hot spots."

PICTURE NEWS

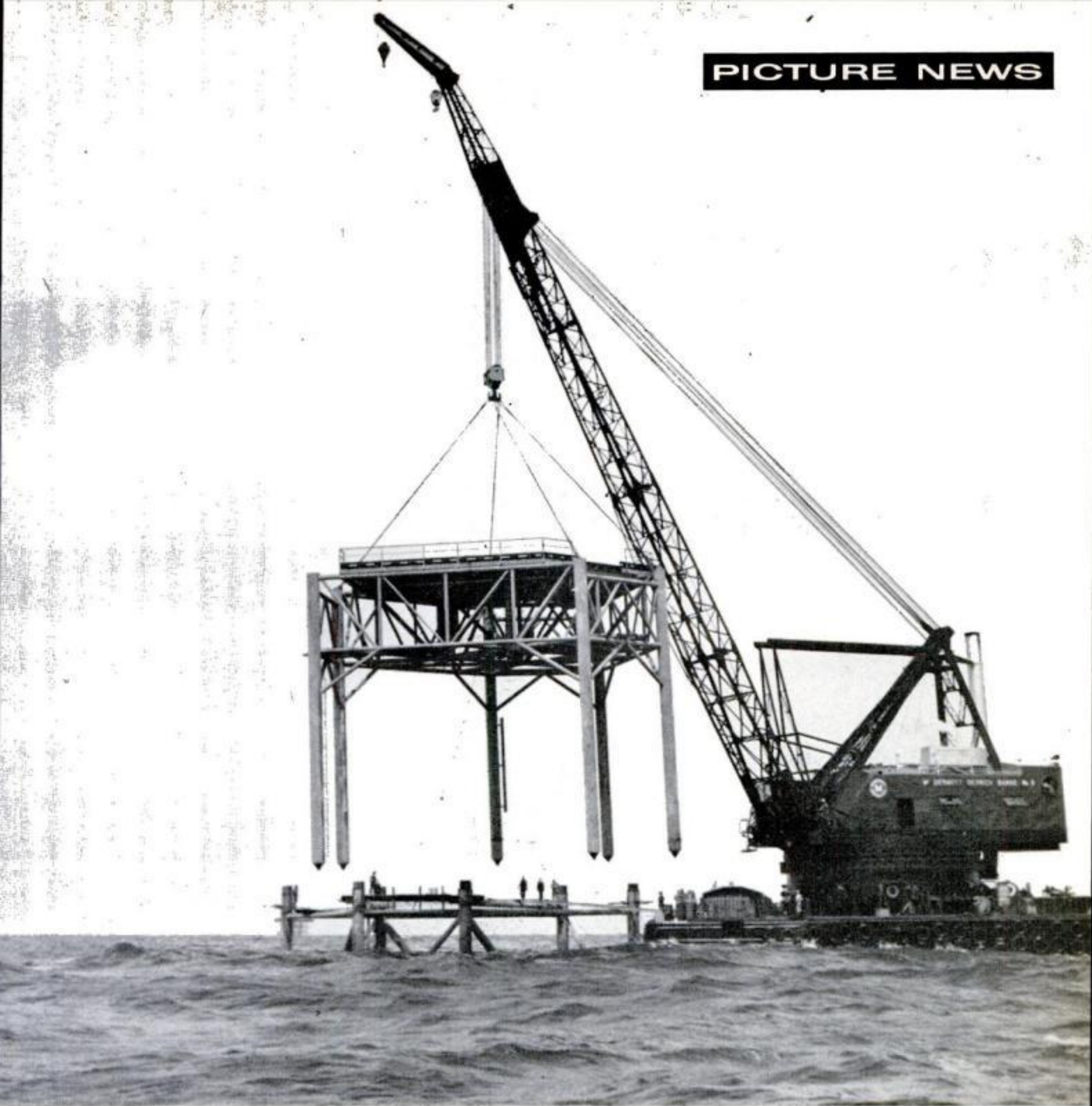




Turbine car has two engines. Latest version of General Motors' gas-turbine experimental car is the Firebird III. The main engine, of 222 hp., has a supplement—a two-cylinder, aluminum midget which supplies electric and hydraulic power for the car's accessories. A control stick starts, stops and turns the bubble-top vehicle.

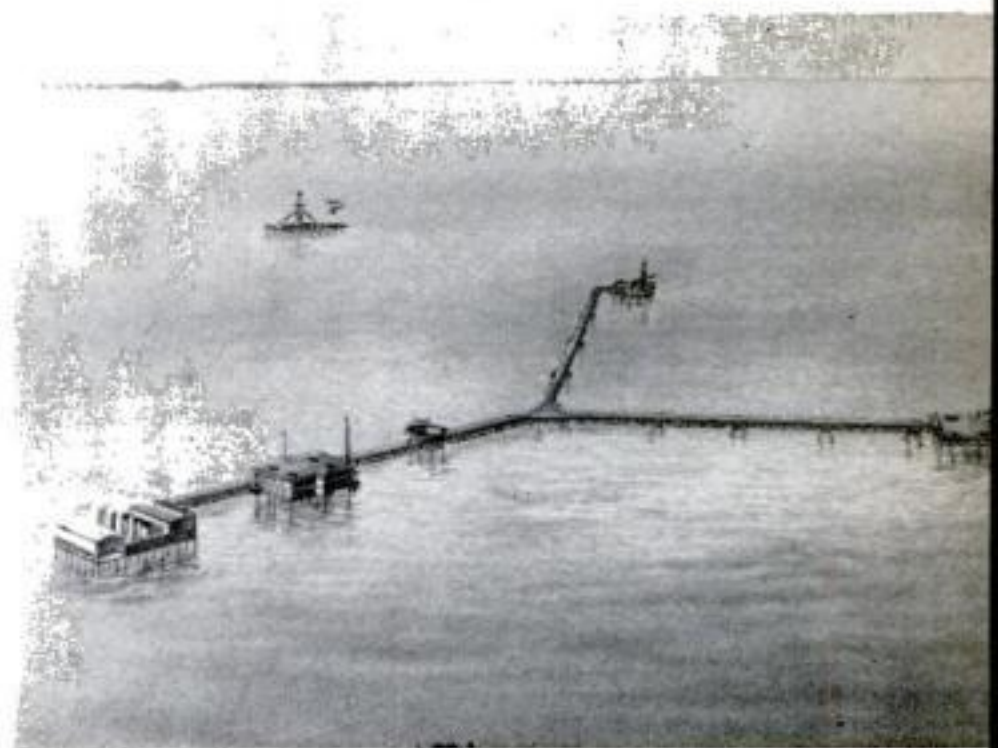
High-wing project. This new Fairchild twin-turboprop F-27 lets local passengers fly by jet-age accommodations. It will serve the seven-state routes of Piedmont Aviation, Winston-Salem, N. C. Its 36-passenger cabin is pressurized, offers full view under the wings, and flaps boost takeoffs from short fields. With its Rolls-Royce Dart engines it does 300 m.p.h.

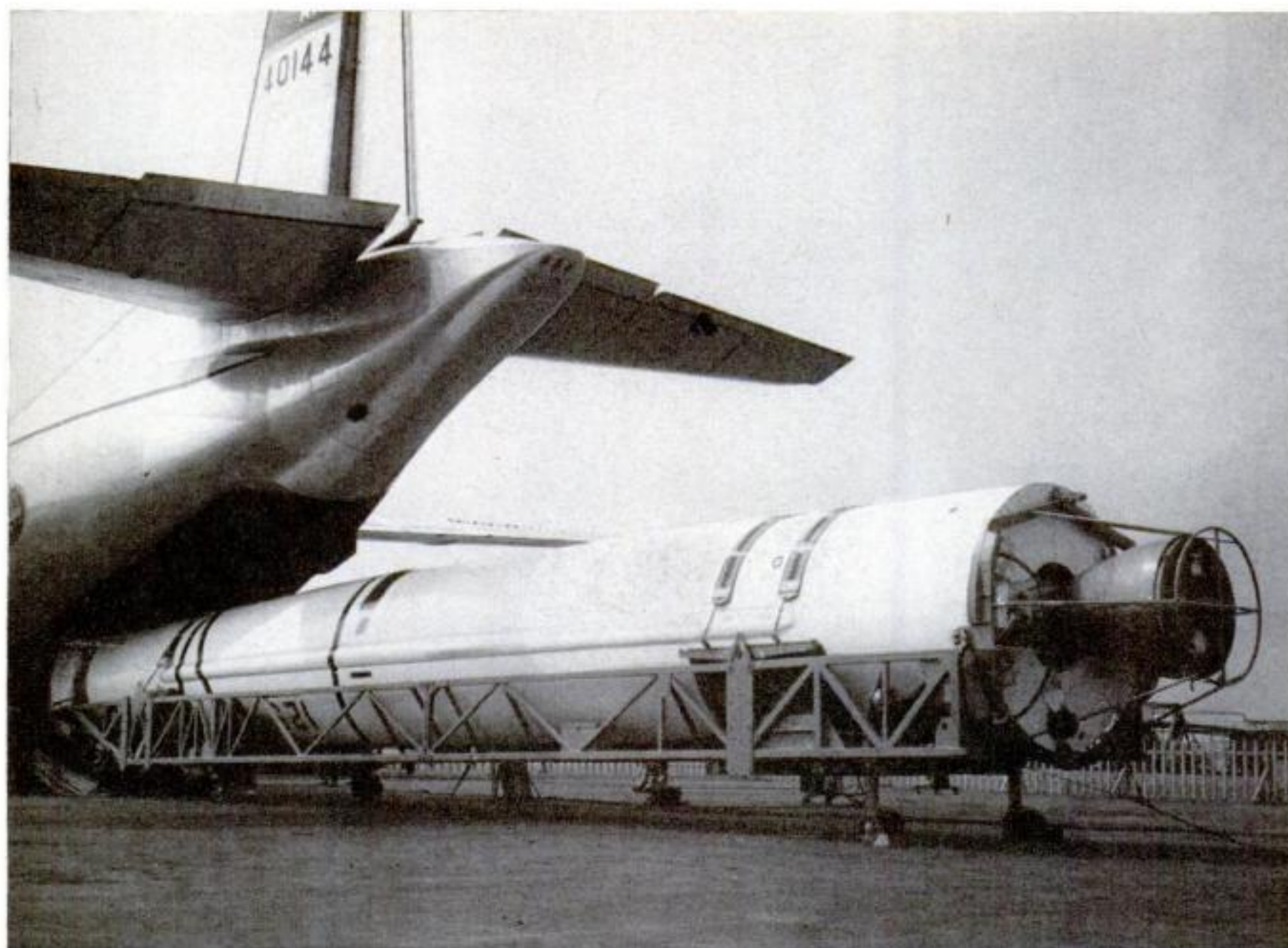




Steel island. First section of a Y-shaped island a mile long and 60 feet high goes into place above off the Louisiana coast. It is being built by Freeport Sulphur Co. for large-scale sulphur-mining operations in the Gulf of Mexico in 1960. The positioning of frame members is being handled here by a 250-ton revolving crane on a 300-foot-long barge.

How the completed island will look is shown in the drawing at right. The buildings are, from left: a heating plant, living quarters for 125 men, a heliport and two drilling platforms. The separate unit in the background is a third platform.



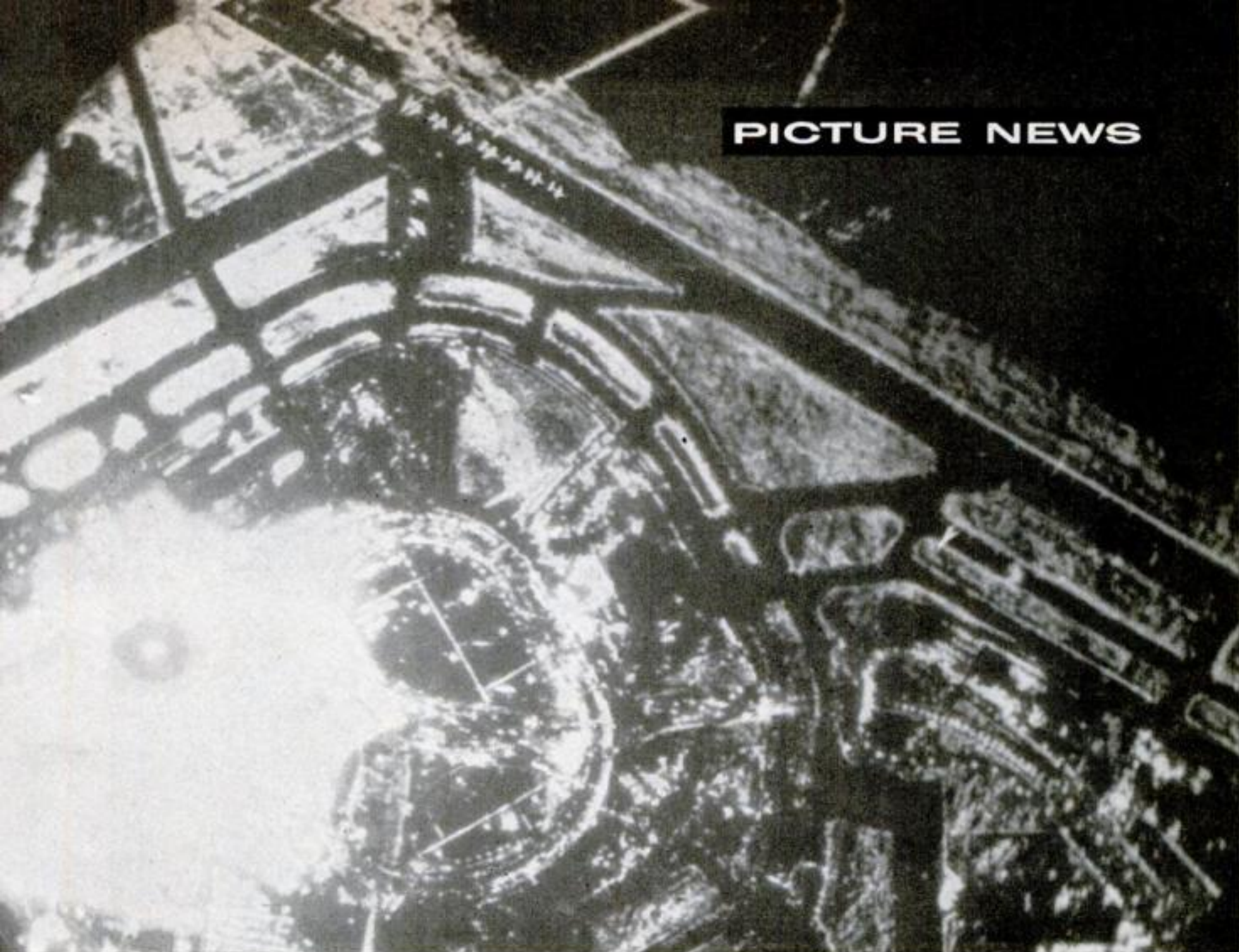


Thor thumbs a lift. Here the Air Force's ballistic missile Thor snuggles into the belly of a Douglas C-133A Cargomaster, this country's largest operational military transport.

The big plane can carry all intercontinental and intermediate-range missiles, and has already demonstrated its non-stop transatlantic capability. An improved version known as the C-133B will have a bigger cargo door, and new Pratt & Whitney T34-9W engines with a range of 4,000 miles at 320 m.p.h.

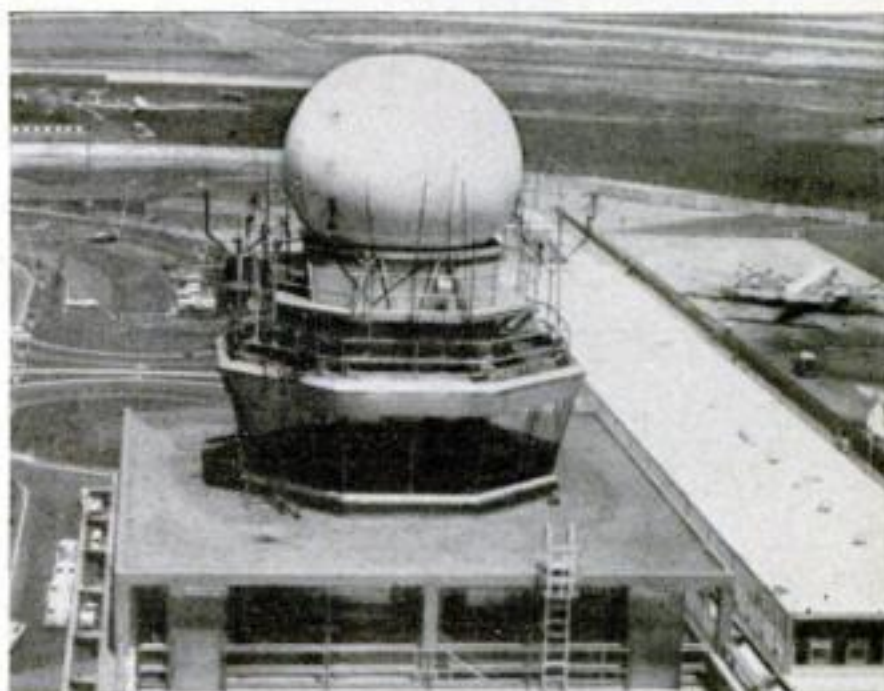
Blow-up steel roof. This air-supported building—a 550-foot, block-long granary, 158 feet wide—has a roof of aluminized steel instead of rubber or plastic. The 50-ton, 2.3-acre metal blanket was pumped up under pressure of 25 to 30 pounds per square foot, anchored to a concrete base and





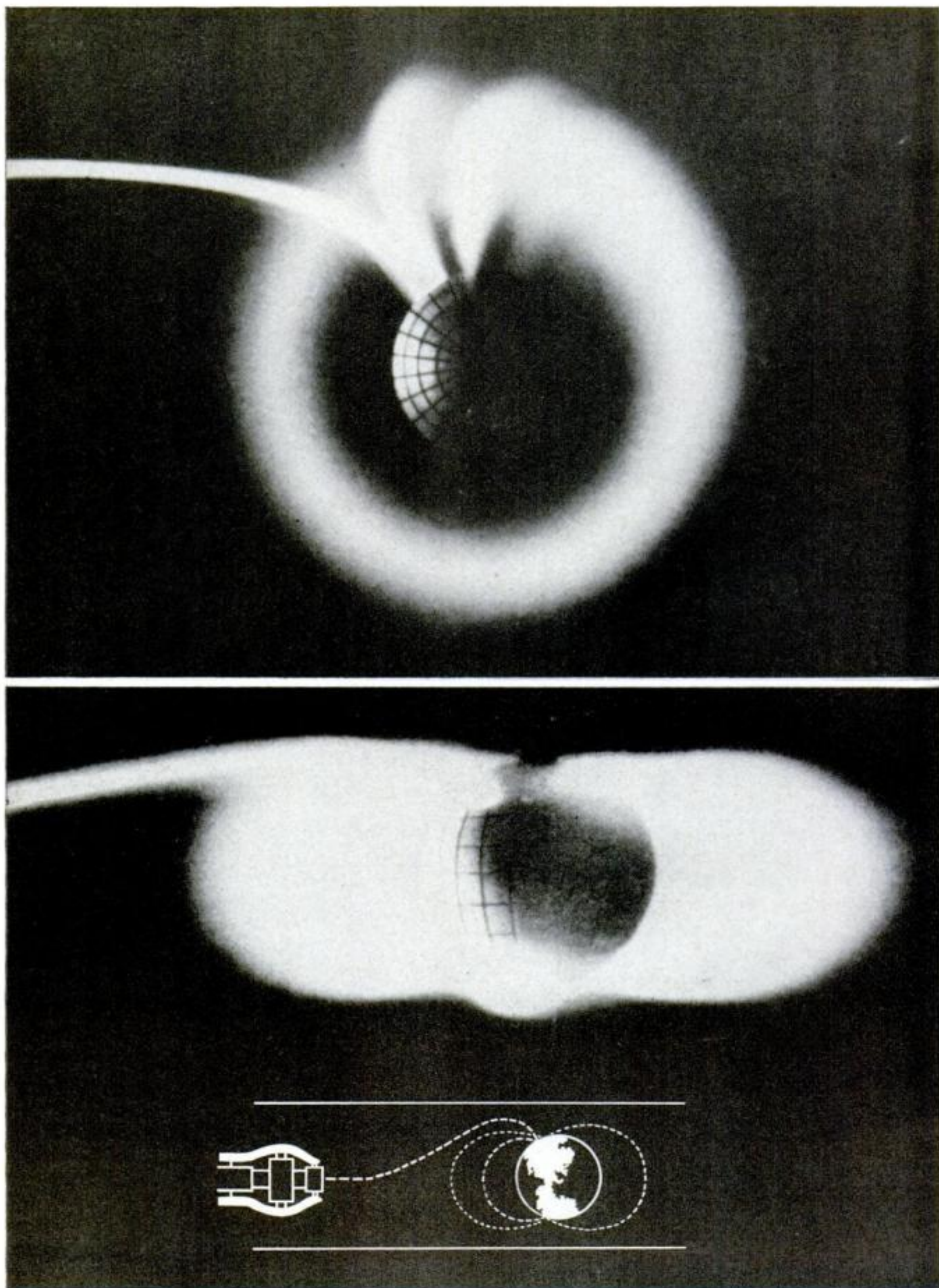
Radar eyes the ground. A high-resolution radar, ASDE (for Airport Surface Detection Equipment), shows planes in outline instead of blips, can see three miles through rain, fog or darkness. It revolves once a second, picks up moving objects, such as the plane landing on the upper runway above, as a series of shapes—one for each time it scans the field.

First installation by the developers, Airborne Instruments Laboratory, is in a radome (right) atop the 11-story control tower at New York International Airport.

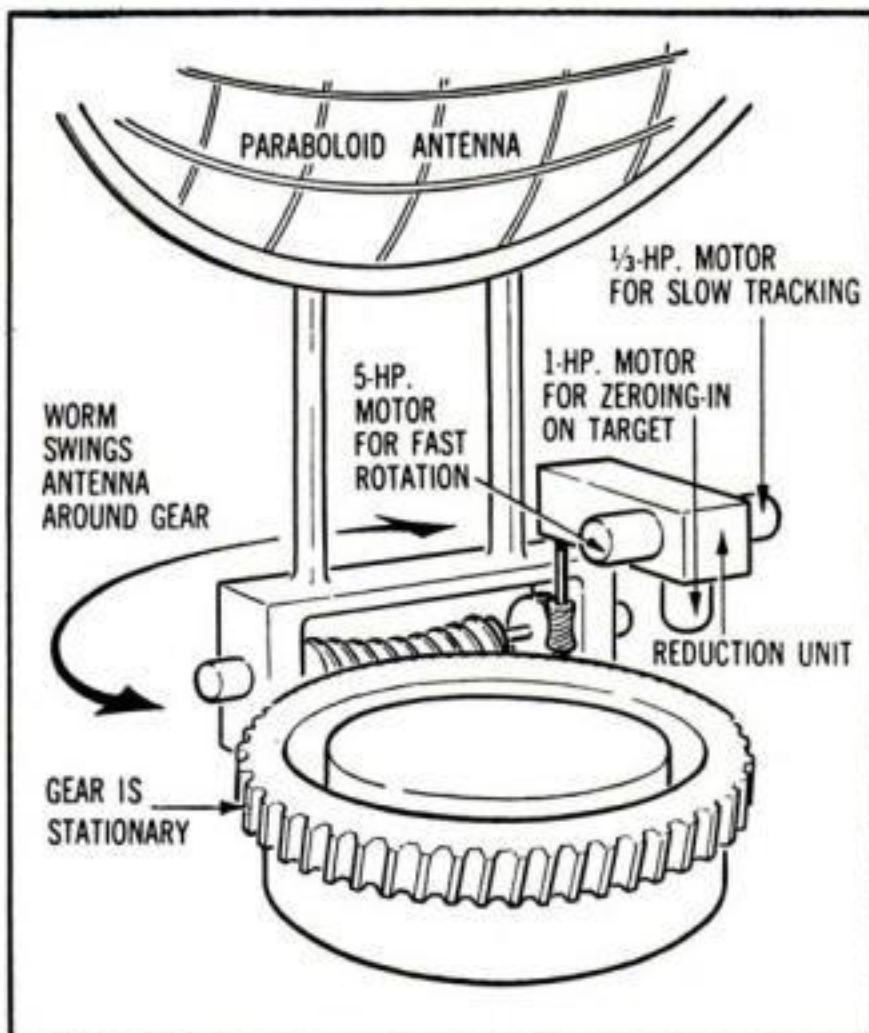
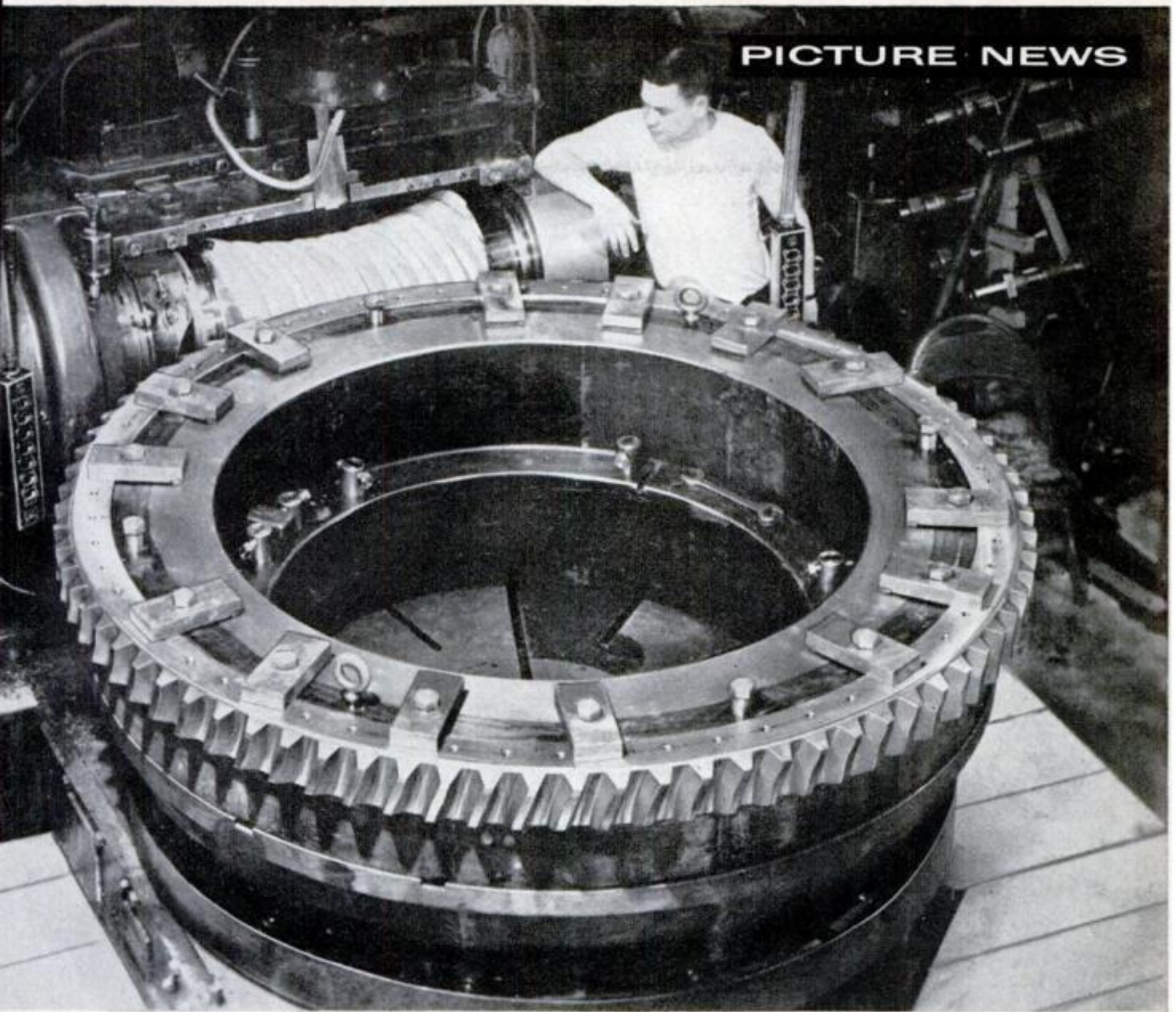


held by flexible seals to steel end walls. Giant fans keep it rigidly inflated; entrance and exit for trucks as well as people are through air-lock doors. The building was erected in five hours at Fort Worth, Tex., by Cargill, Inc., to store 1,800,000 bushels of grain.





Man-made aurora. Above are two views of an aurora from different angles—taken in a nine-inch-diameter glass tube. The tube, a Stoermertron used by Dr. Willard H. Bennett of the U. S. Naval Research Laboratory, contains a cathode-ray gun and a magnetized globe. The gun acts as the sun, sending into the magnetic field a stream of electrons simulating sun-ejected protons. Varying the aim changes the pattern.



Geared to the stars. This eight-foot worm drive will rotate the antenna of an 84-foot radio telescope as slowly as one revolution per day. Final step in a 1,440,000-to-1 speed reduction, the drive handles a million pound-feet of torque to resist 100-m.p.h. winds.

The gears, shown here being checked for tooth contact in the Traverse City, Mich., plant of Cone-Drive Gears, are of the double-enveloping type. The worm is narrow-throated so that one-eighth of the gear teeth are in contact at all times. Backlash is held to .0012 inch.

In the telescope, being built by D. S. Kennedy & Co., of Cohasset, Mass., the gear will be stationary while the worm with its motors and antenna will track around it. Three separate drives will provide a fast slewing and a variable back-and-forth scanning speed besides one-turn-a-day tracking of the sky.

NEW WAY TO MODERN

A multimillion-dollar crash program is racing high-school physics. In prospect: equally

SINCE we entered the Space Age, exactly a year ago, science education in U.S. high schools has been sharply criticized by physicists, congressmen, educators, military leaders, and just plain parents. Now something is being done about it.

Leading a large-scale attack on antiquated science courses is a stocky, steely-haired, 53-year-old M.I.T. physics professor, Jerrold R. Zacharias. As chairman of the Physical Science Study Committee, Zacharias—an experimenter by nature—is taking readings on the biggest experiment of his career: the PSSC's new and improved physics course.

Right now an experimental group of 15,000 teen-agers in 40 states, the District of Columbia and several Canadian provinces are taking home the red-bound Part One of the radical physics text. You wouldn't recognize it as the subject you once studied. And the differences involve more than a revised text:

- Physics is presented the way a research physicist sees it, as a way of using deductive reasoning and every conceivable measuring tool to explore the universe.
- The physics taught is modern physics. The course does *not* duck big, important ideas like quantum theory.
- Great pains are taken to "build an image" of the physicist as

Window on Tomorrow



TEACH SCIENCE

BY MARTIN MANN

*to perfect wholly new ways of teaching
drastic changes for mathematics and chemistry*

a hard-working citizen with an interesting and valuable—but not queer—job.

- Much of the teaching is done with movies made especially for the course.

- The laboratory work is an exercise in inventive reasoning, not practice in operating factory-built instruments.

- Most significant, the entire course is being prepared in a totally new and different way. It is not the spare-time work of one or two teaching specialists, but the group effort of hundreds of experts from many fields, working with large grants from philanthropic foundations and the U.S. Government itself.

That's a quick rundown. This fresh approach to teaching—both deep and thorough—is squarely aimed at the great American goal of the highest-quality education for the greatest number of people.

This is not, of course, Zacharias' personal project or even an M.I.T. project. It involves the ideas and work of the best brains from universities, laboratories, publishing houses and movie studios all over the country. But the spark that lit the fire was Zacharias', and much of the energy that keeps it roaring full blast is his, too. So he is bound to get much of the credit, if any, and all the blame, if any.

How it started. After the war a favorite amusement at physicists' beer parties was "Take Away Your Billion Dollars," a song lamenting

the good old days, pre-A-bomb, when physicists were impoverished and unobtrusive, and a pro like Zacharias explained his job to his mother as "the same as a chemist's, only it doesn't smell so bad."

But the sardonic lament boomeranged. Physicists found themselves counseling Very Important People in government, finance and industry. Their advice became essential to billion-dollar decisions affecting not only national security, but the future of science and, indeed, mankind.

To their dismay, they discovered that they could not talk to many of these VIPs, who were dangerously ignorant of science—physics, particularly—and worse yet, *proud* of their ignorance. Such people looked on physics as a cult—necessary but faintly evil—that was practiced by witch doctors whose mumbo-jumbo was not meant to be understood by normal human beings.

Obviously, Something Had to Be Done. Also obviously, a good place to start was the high-school physics course. It was the only physics instruction available nationwide to most people, and was actually taken by more than half the brighter youngsters, the ones likely to grow up to positions of influence. The course had long been criticized as outmoded and incomplete. Now its inadequacy was causing real harm.

After some talk-filled years, two things happened simultaneously:

- Zacharias proposed a plan of action.
- Money became available.

So Zacharias was it. His original proposal had been movies to supplement standard physics courses: "ninety films of 20-minute duration, complete with textbooks, problem books, question cards and answer cards." But he and his associates soon saw that this was not enough. An entirely new course was needed.

Crash program. The Physical Science Study Committee opened for business only two years ago. It operates like a war-time crash program—understandable, since Zacharias is an old hand at this technique (a veteran of World War II's famed radar-development center, the M.I.T. Radiation Laboratory).

If you remember what it was like around an aircraft plant or a key Army base in the early Forties, you quickly spot the familiar signs.

How to weigh a human hair —with straw, needle, foil



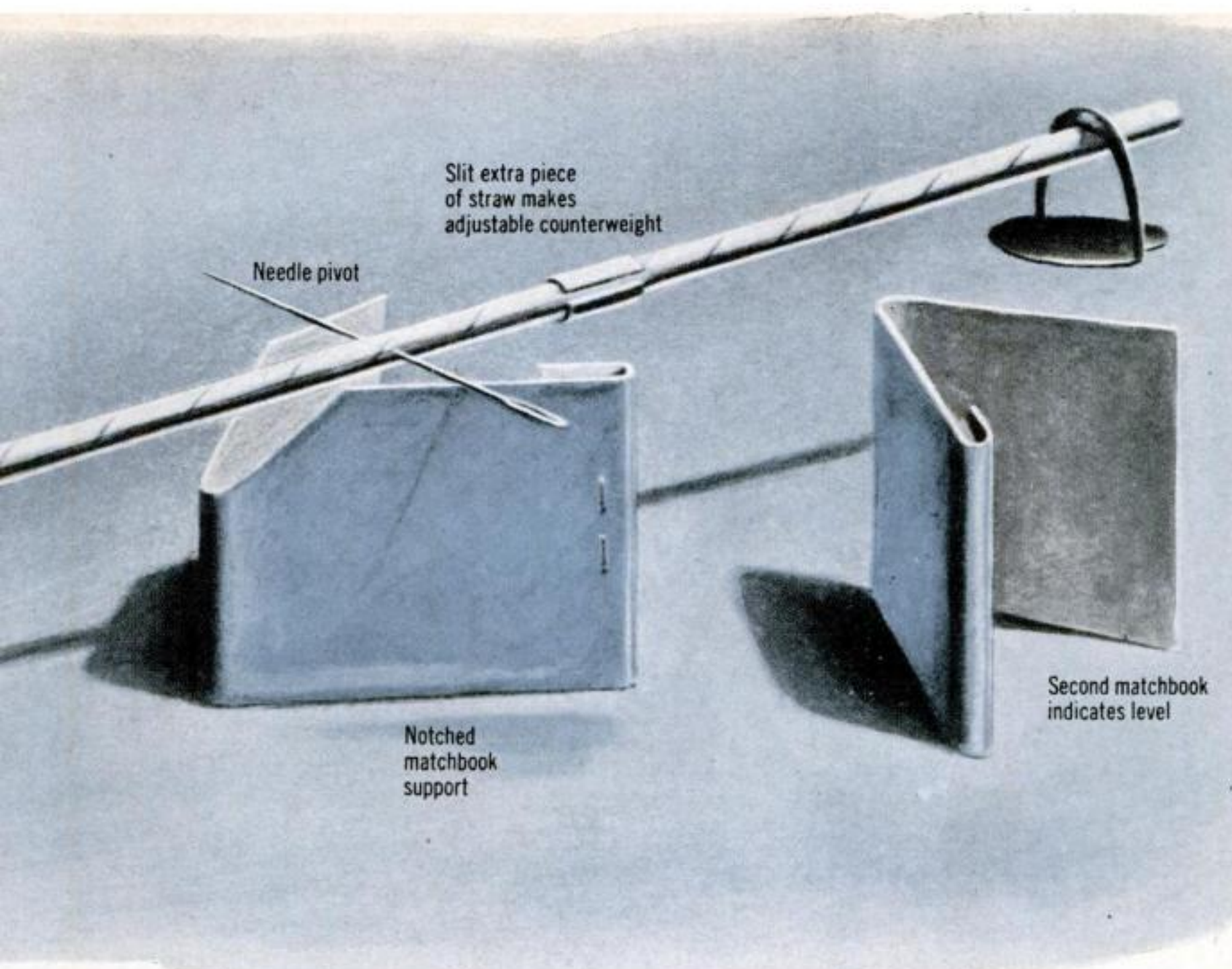
Soda-straw balance, accurate to 1/60,000 ounce, is typical of the new course's homey lab equipment, which emphasizes the funda-

.....

There is the fresh-eye approach—unusual outside talent trained on a new problem. The PSSC includes plenty of teachers, as you'd expect, but also research scientists like Hans Bethe, I. I. Rabi and Philip Morrison (who wrote Part One of the text); executives like Vannevar Bush, Bradley Dewey, Mervin Kelly and Edwin Land; movie makers like Frank Capra and Warren Everote; journalists like Benjamin Richards, George Waltz and Stephen White.

There is the cramped, makeshift housing. Headquarters is a converted Stop & Shop supermarket; a branch office occupies an old tire store across Massachusetts Ave. from M.I.T.; the movie studio is a remodeled theater (with an unacademic touch supplied by the sign for the Watertown Billiard Academy, still operating downstairs).

Most of all, there is disregard for conventional economics and conventional



mentals of physics. Students make it in a few minutes (you can, too), use small paper squares as "standard weights." Key point of

experiment is calibrating paper weights. How is that done without a lab balance? (Answer in text.)

working hours. Twelve-hour days and seven-day weeks are common if not standard. A staff man confides: "You can't stave off drastic last-minute changes by saying they'll cost too much. You win only if you say they'll take too much time."

Will this lavish expenditure of talent and money pay off? Zacharias considers it an experiment (a favorite remark: "I am an experimenter"). It will take three more years to complete, another five years to find out if it worked. But even now there are results. And they are impressive.

The textbook. The 15,000 youngsters serving as guinea pigs in the experiment this year will get four magazine-like books. In outline, they go like this:

- Red cover—measurements, starting from the most homely methods (hand for space, heartbeat for time) and then showing how such crude techniques can be extended and refined to reveal the fasci-

nating nature of the universe, from the size and distance of the stars to the intimate structure of the invisible atom.

- Yellow cover—light, comparing it first to a stream of bullets, then, when this theory "gets into trouble," switching to waves.

- Green cover—motion of falling bodies, satellites, and solar system, leading to the law of gravitation; the conservation of mass and energy; heat.

- Blue cover—electricity, magnetism and electromagnetism, bringing the student back to waves, light and a rigorous discussion of atomic theory.

Even more striking than what is in the textbook is what is left out: sound, for instance (the student is expected to cope with this from his knowledge of wave action alone), electrical circuitry, and all the how-it-works explanations of engines, airplanes, radio and so on.

So much space is devoted to a complete



Physicist on the set: Chairman and spark plug of the committee guiding the new physics course, Dr. Jerrold R. Zacharias, watches production of one of 70 movies that go with it. The complete program includes not only such films and the textbooks, but also teacher's guides, laboratory experiments and a complete library of books for extra reading.

explanation of the important fundamentals—waves, particles, atoms, measurements, motion—that something had to give. The technology of machines—long a staple of high-school physics—suffers the most. The PSSC attitude: It isn't really science.

The laboratory. Students are bound to be startled by what faces them here. Few factory-made instruments will be jiggled to give known-in-advance answers (such as the boiling temperature of water). The lab-equipment list reads like your wife's shopping notes. It includes (for 60 students) such things as: 50 razor blades, 1 gross swab sticks, $\frac{1}{2}$ gross tongue depres-

sors, 100 clothespins, a roll of aluminum foil and a package of rubber bands, assorted.

The youngsters will make most of their equipment from these common household materials. The idea is not to save money (it doesn't), but to help the students learn fundamentals by performing fundamental experiments with simple instruments. Simple instruments make the principles involved stand out clearly; complex professional devices don't.

For instance: How do you weigh extremely light things—say a human hair? The lab book shows how to make a balance sensitive enough for this job from two soda straws, a needle, aluminum foil and an empty matchbook.

What do you use for weights? Paper. Weigh a whole ream of thin paper on any scale, divide by the number of sheets (usually 500) to get the weight of one sheet, then compute the weight of a carefully measured snip by comparing the snip's area with the area of a sheet. (Try this yourself at home; you can make the balance—see the drawing—in 15 minutes.)

What do the kids learn from this? The weight of a hair doesn't matter, really. But they see that you can get at something very small and difficult (the weight of the hair) by methodically working down from something big and easy (the weight of the ream of paper). And there are other points, some spelled out in the lab book, some left for a good teacher to draw out of the students themselves.

The films. These are supercolossal. The PSSC plans to spend \$1.5 million on 70 movies, running 10 to 30 minutes each. Fifteen are already finished. They are slick, fascinating—and accurately informative. Each film is intended to fill at least nine functions, but mainly to:

- Help students visualize some ideas.
- Show students things they can't see in the lab (eclipses, the pressure of light).
- Let students watch real, live physicists at work.

The actors in the films are physicists,

[Continued on page 254]

For more information . . .

IF THE high school in your town wants to try the new physics course experimentally next year, the physics teacher should write directly to the Physical Science Study Committee, 164 Main St., Watertown 72, Mass.

Anybody who wants the textbook can buy it (\$5) from the PSSC. The lab manual, films and teacher's guide are not yet available.

The outside-reading paperbacks should be available in early 1959 from Doubleday & Co., 655 Fifth Ave., New York 22.

New Ideas from the Inventors

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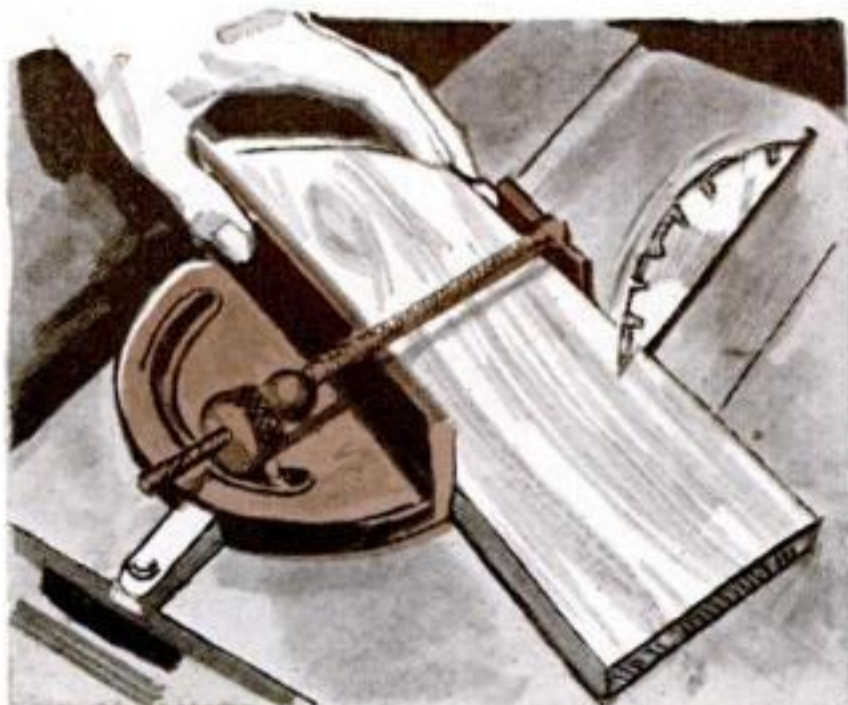


1 Ducking Duck Decoys Ducks. Simulated diving and feeding, according to this recent patent, are highly effective decoying motions. By alternately shuttling

water and gas in and out of the compartments, valves in this molded-plastic duck would cause the decoy to bob. The gas could be produced by a chunk of dry ice.

2 Miter Clamp Prevents Slips. With a clamp like this holding it against the miter gauge, a board couldn't slip or chatter when you moved it into the saw at an angle. Tightening a threaded rod would grip the stock securely between the gauge and a pivoted clamp plate.

3 Switch Combination Locks Car. You couldn't be careless about your car keys if you locked the ignition with a panel of switches. The car could be started by anyone who knows the code, but a thief would have an impossible job finding the right combination of positions.



Please turn the page for more new ideas

OCTOBER 1958 **147**



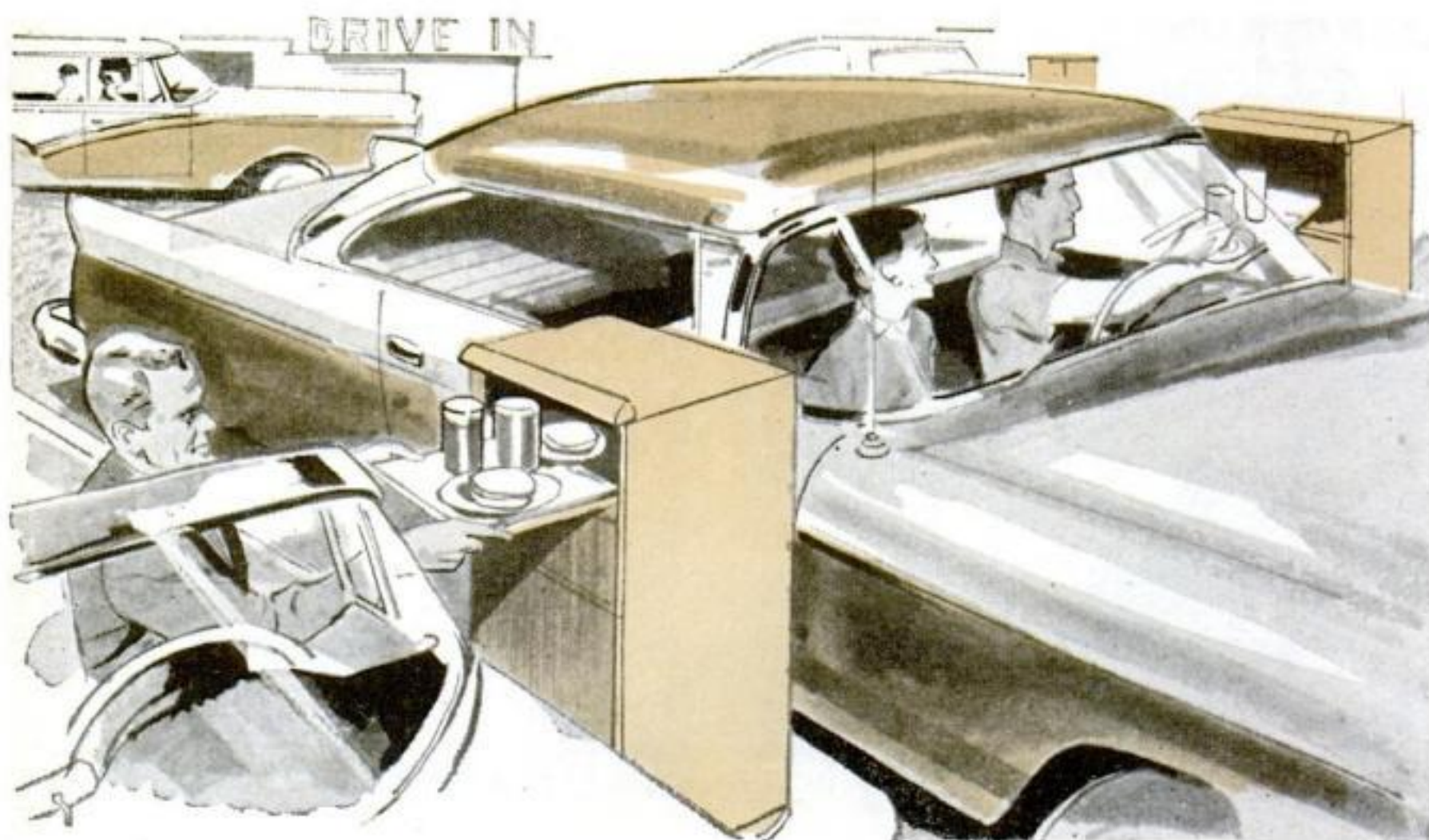
4 Tiller Steers Car Safely. A padded, Y-shaped tiller, says this GM patent, would be safer in accidents, give a more positive indication of wheel angle, increase leg room, and improve a driver's view. Buttons in the bar ends could control lights, brakes or other functions.



5 Watch Band Coils Your Notes. You could keep important reminders right near your fingertips with a memo tape like this coiled inside your watch band. The replaceable paper ribbon could be moved either way, and a window in the band would expose one section at a time.

6 Conveyor "Car Hops" Your Food. Hot dishes would arrive faster—and hotter—in any weather at a drive-in that delivered food from kitchen to carside by an

express conveyor. You'd call your order over an intercom; trays would travel underground from the kitchen, then ascend an elevator next to your parking station.





7 Sash Lock Triggers Itself. You couldn't forget to lock a window when you closed it if it were fitted with a catch like this. In open position the rotatable latch would be held against a spring; closing the sash would automatically trigger the catch so it could snap itself shut.

8 Bent Tack Pushes Itself Out. To make it easy to remove thumbtacked notices without tearing either your fingernails or the paper, this inventor would curve both tack and head. Pressing on the lower part of the head would pull the tack by levering it outward. Using the bend line as a fulcrum would also make it easier to guide and insert the tack.



9 Hand-Light Unsnarls Traffic. The lens-changing mechanism in this portable traffic light would give an operator his choice of signal colors and steady or flashing beams. With it, a policeman could guide traffic past temporary or accident-caused tie-ups. It could also be used for ship or aircraft signals.

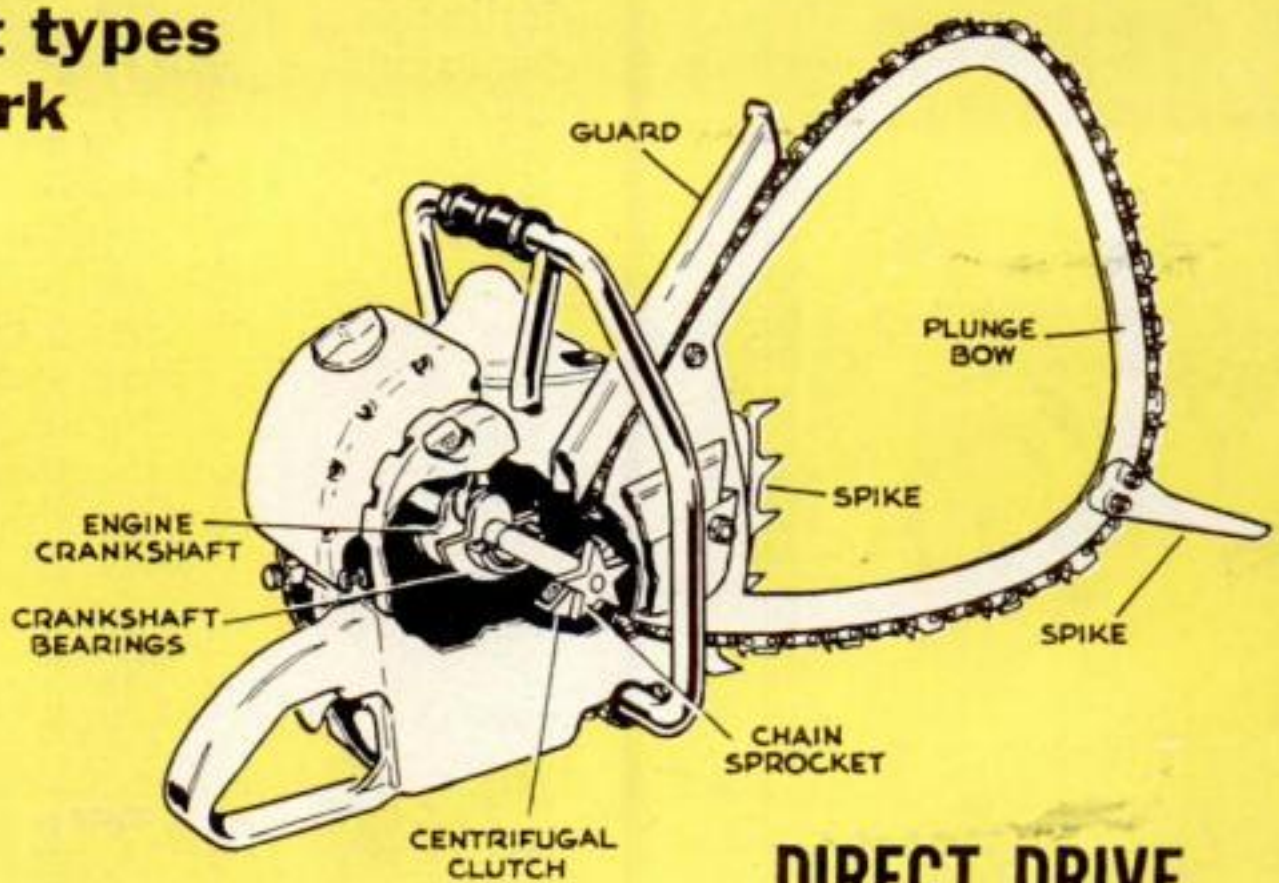
The following patents have been issued on these inventions: 1. Patent No. 2,814,898 to J. Fluke, Seattle, E. Albertson, Oswego, Ore., and D. Peabody, Portland, Ore.; 2. No. 2,752,960 to H. Poeltl, Milwaukee; 3. No. 2,819,770 to K. Gibbs, Bristol, Eng.; 4. No. 2,827,801 to A. Ingolia, Detroit; 5. No. 2,827,309 to M. Fred, Lebanon, Ohio; 6. No. 2,827,130 to T. Daijotes, Van Nuys, Calif.; 7. No. 2,480,016 to F. Granberg, Chicago; 8. No. 2,751,807 to K. Harre, Bromsten, Sweden; 9. No. 2,751,581 to D. Waltman, Alexandria, Va.

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington 25, D. C., at 25 cents each. To write to an inventor, if the address given above is insufficient, you may address him (by name and patent number) in care of the Commissioner of Patents.



How the different types of chain saws work

All *gas saws* have a centrifugal clutch which engages the chain only when the engine is revved up. Direct-drive saws, like the first at right (shown with special accessory bow blade), are high-speed cutters requiring little operating pressure. Gas saws with gear drive are heavier, but they are harder to stall, and their lower chain speed produces less wear on the guide and chain. *Electric saws* (far right) require no clutch, but are geared down to develop adequate torque. All geared chain saws require moderately heavy operating pressure.



DIRECT DRIVE

How to Buy a Chain Saw

Consumer
News

All these machines make woodcutting fun—but one may be best for you. Here's what you should know before you buy

By Phil McCafferty

HOME owners, farmers and sportsmen bought nearly a quarter of a million light chain saws last year. These little worksavers eat cleanly through a 12-inch log in as many seconds, and rack up more cordwood in an hour than you could cut by hand all day.

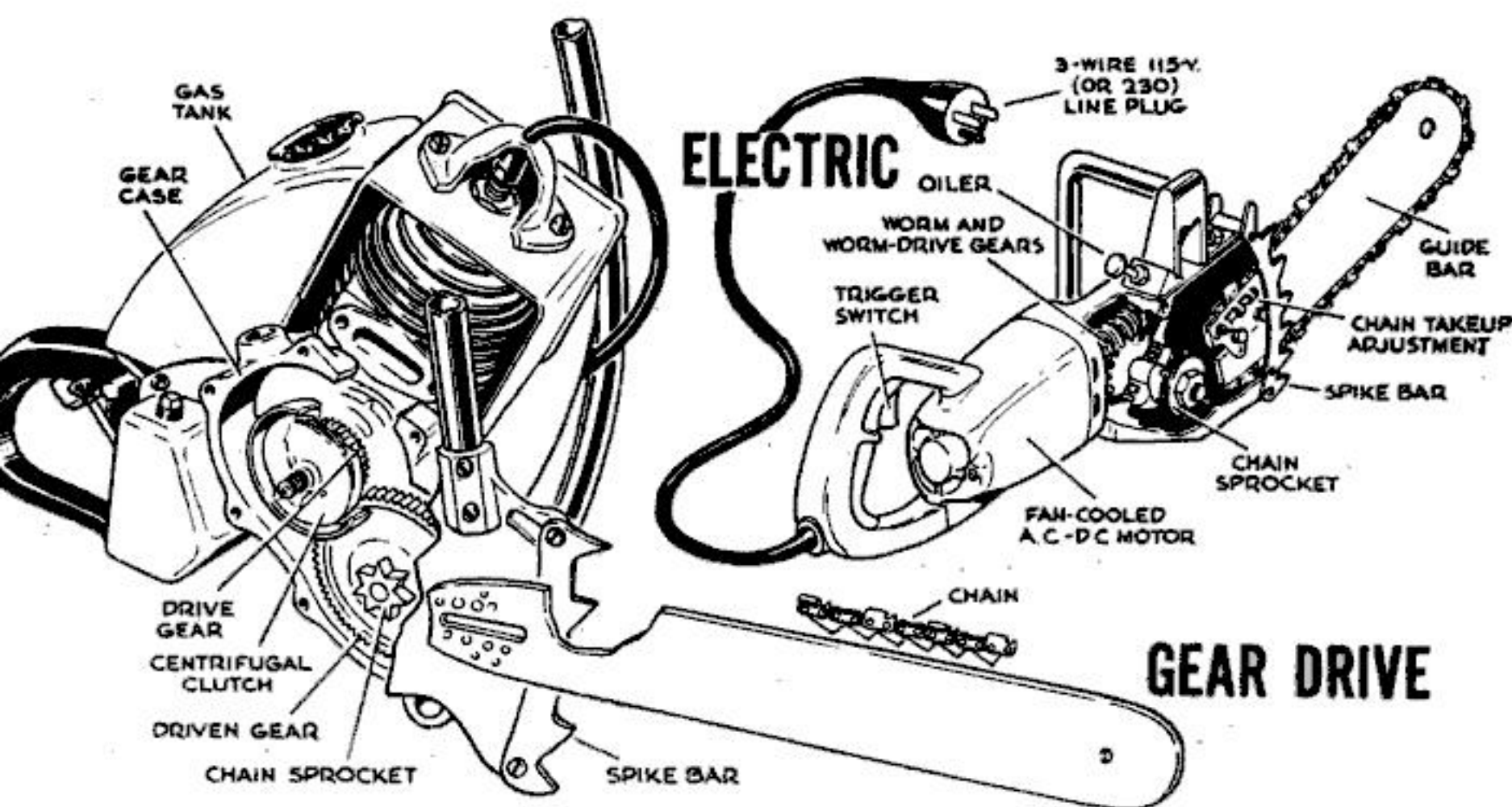
When shopping for a chain saw it's important to consider your particular woodcutting requirements. How big a saw? A gas- or an electric-driven rig? If gas, do you want direct or gear drive? What features make for convenient operation?

Electric chain saws are powered by universal AC-DC motors—huskier versions of those in electric drills. They need no

clutch; the chain starts and stops when the motor is switched on and off. Standard electricians use 115 volts, but some makers will provide 230-volt motors on order.

On all but the smallest units, figure on using a separate 30-amp circuit, preferably with the outlet close to the meter. Saws generally come with from six to 10 feet of three-wire cord. It's important that you use the third wire for grounding, so when you buy an extension cord—12 gauge or heavier—be sure to get the three-conductor kind. Don't use more than 200 feet. Line loss on longer extensions may drop voltage and burn out the armature windings in the motor.

Gas chain saws are powered by air-cooled two-cycle engines. Very powerful



How the Popular

MAKE	MODEL	SIZE (length of guide bar in inches)	TYPE	DRIVE (direct or gear)	WEIGHT (pounds)	CLOSEST CUT (inches above ground)	MAKE OF ENGINE OR MOTOR	ENGINE DISPLACEMENT (cubic inches)	HORSEPOWER	FUEL SYSTEM (float or diaphragm)	CHAIN-OILING SYSTEM	APPROXIMATE LIST PRICE ^a
BOLENS	3400 series	14-20-24	gas	D	21 ^h	n.a.	Power Prod.	4.7	n.a.	F	manual	\$170
	3500 series	16-20-24	gas	D	21 ^h	n.a.	Power Prod.	4.7	n.a.	D	manual	\$193
	3600 series	14-20-24	gas	G	24 ^h	n.a.	Power Prod.	4.7	n.a.	D	manual	\$225
BURNS	20	17-20-23	gas	D	n.a.	flush	n.a.	5.1	n.a.	D	manual	\$210
	21	17-20-23	gas	D	n.a.	flush	n.a.	6.45	n.a.	D	manual	\$230
CHAIN TOOLS	RC18D	20	gas	D	29½	1"	Power Prod.	n.a.	3	D	semi-auto.	\$220
	RC5HP	20	gas	D	25	1"	Power Prod.	n.a.	3 ^c	D	semi-auto.	\$240
CHOREMASTER	A-1193	16-20	gas	D	31	n.a.	n.a.	n.a.	n.a.	F	manual	\$160
	A-1195	16-20	gas	D	31	n.a.	n.a.	n.a.	n.a.	F	manual	\$190
	A-1197	16-20	gas	D	31	n.a.	n.a.	n.a.	n.a.	D	manual	\$215
	A-1045	20	gas	G	40	n.a.	n.a.	n.a.	n.a.	F	manual	\$228
CLINTON	D2-1	16-20	gas	D	n.a.	2"	Clinton	n.a.	n.a.	F	manual	\$160
	D2-D	16-20	gas	D	n.a.	2"	Clinton	n.a.	n.a.	D	manual	\$175
	D3-1	16-20	gas	D	n.a.	2"	Clinton	n.a.	n.a.	F	manual	\$190
	D4-1	16-20	gas	D	n.a.	2"	Clinton	n.a.	n.a.	D	manual	\$215
DAVID BRADLEY (Sears, Roebuck)	0881	14-16	elec.	G	n.a.	n.a.	n.a.	—	n.a.	—	manual	\$106
	325D	16-20	gas	D	22	1¾"	n.a.	n.a.	n.a.	D	manual	\$144
	325G	20	gas	G	25	flush	n.a.	n.a.	n.a.	D	manual	\$183
ECLIPSE	Wasp 700	16-20-24	gas	D	20 ^h	flush	Power Prod.	n.a.	3.5	F	manual	\$155
	Wasp 800	16-20-24	gas	D	20 ^h	flush	Power Prod.	n.a.	4	D	manual	\$180
HOFFCO	88M	15-18-23	gas	D	n.a.	flush	West Bend	6.45	n.a.	D	manual	\$135
HOMELITE	EZ6	12-17-21	gas	D	19	1¼"	Homelite	n.a.	6	D	manual	\$240
INDIAN	Thunderbolt	16-20-24	gas	D	n.a.	flush	n.a.	6.5	n.a.	D	semi-auto.	\$240 ^d
	Thunderbolt	16-20-24	gas	G	n.a.	flush	n.a.	6.5	n.a.	D	semi-auto.	\$240 ^d
LANCASTER	200-A	14-16-19	gas	D	20.5	n.a.	Power Prod.	n.a.	3	F	auto.	\$150
	450	16-19-24	gas	D	22	n.a.	Power Prod.	n.a.	3	F	manual	\$180
	400-B	16-19-24	gas	D	22.5	n.a.	Power Prod.	n.a.	3	D	manual	\$195
LOMBARD	D-40	16	gas	D	24	flush	Power Prod.	n.a.	4	F	auto.	\$160
	DD2F	12-16-20-24	gas	D	n.a.	flush	Power Prod.	n.a.	4	F	auto.	\$177
	DD2D	12-16-20-24	gas	D	n.a.	flush	Power Prod.	n.a.	4	D	auto.	\$200
	44	12-16-20-24	gas	G	n.a.	flush	Power Prod.	n.a.	4	F	auto.	\$204
	46	12-16-20-24	gas	G	n.a.	flush	Power Prod.	n.a.	4	D	auto.	\$243
	Super 6	16-20-24	gas	D	n.a.	4½"	West Bend	n.a.	6	D	semi-auto.	\$244

NOTES: This chart is limited to chain saws selling for \$250 or less. Specifications are as quoted by manufacturers. n.a. This information not available from manufacturer.

^aWhere more than one saw size is listed, price is for the shortest, unless otherwise noted. Figure approximately \$2 extra for each additional inch.

^bWeight of power unit without saw and guide bar.

for their size, they wind up to as much as 8,000 r.p.m. They all have automatic-rewind pull-cord starters, magneto-shorting switches, and centrifugal clutches to stop the chain at idle.

Comparative advantages. Electric chain saws tend to be cheaper, lighter and handier, if your work isn't heavy and you have access to electricity. (Where there's

no house current you can still use them with a two-kilowatt gasoline-driven generator.) They can also be tilted to cut in any direction.

Gas chain saws have much more power, capacity and cutting speed. Unlike electrics, they don't have to be levered into the wood, using bumper spikes as a fulcrum. And of course they eliminate the

Chain Saws Compare

MAKE	MODEL	SIZE (length of guide bar in inches)	TYPE	DRIVE (direct or gear)	WEIGHT (pounds)	CLOSEST CUT (inches above ground)	MAKE OF ENGINE OR MOTOR	ENGINE DISPLACEMENT (cubic inches)	HORSEPOWER	FUEL SYSTEM (float or diaphragm)	CHAIN-OILING SYSTEM	APPROXIMATE LIST PRICE*
McCULLOCH	Mac D-30	12-14-18-24	gas	D	17 ^b	flush	McCulloch	4.9	3.8	D	auto.	\$150
	D-36	12-14-18-24	gas	D	17 ^b	flush	McCulloch	4.9	5.8	D	auto.	\$180
	Mac 35A	12-16-20-24	gas	G	20 ^b	1½"	McCulloch	3.3	3.5	D	manual	\$180
	Super 44A	12-18-24	gas	D	19 ^b	4"	McCulloch	5.3	7	D	manual	\$240
MONO	"7" series	16-20-24	gas	D	32	flush	Power Prod.	8.1	6	D	manual	\$170
MONTGOMERY WARD	WD45	16	gas	D	24	2¼"	Wards	n.a.	3	D	manual	\$170
	WD55	16-20	gas	D	24	2¼"	Wards	n.a.	5	D	manual	\$220
PIONEER	RA	16-20-24	gas	D	27	n.a.	Pioneer	6.2	5	n.a.	manual	\$190
PORTER-CABLE	154	14	elec.	G	18	flush	n.a.	—	2	—	manual	\$135
	156	16	elec.	G	18.5	flush	n.a.	—	2	—	manual	\$145
	534	14-16-20-24	gas	D	23.5	3¼"	Power Prod.	n.a.	4.5	F	manual	\$170 ^c
REMINGTON	11E12	12	elec.	G	12	n.a.	n.a.	—	n.a.	—	manual	\$105
	11E12D	12	elec.	G	18	n.a.	n.a.	—	n.a.	—	manual	\$120
	Silver Logmaster	18-24	gas	D	26	1¼"	Remington	n.a.	3	D	manual	\$229
ROTOTILLER	ES	16	elec.	G	12	n.a.	n.a.	—	¾	—	manual	\$129
SKIL	605	14	elec.	G	16¼	5"	Robbins & Myers	—	n.a.	—	manual	\$135
	606	20	elec.	G	17¼	5"	Robbins & Myers	—	n.a.	—	manual	\$150
STEVENS	Cobra Special	14-16-19	gas	D	22	1½"	Power Prod.	4.7	3½	D	manual	\$150
	Cobra Standard	14-16-19	gas	D	24	1"	Power Prod.	4.7	3½	D	manual	\$185
	Cobra Super	19-22-30	gas	D	26	1"	Power Prod.	8.1	6½	D	manual	\$250
STRUNK	Sure-Kut AP	14-16-19	gas	G	25	n.a.	n.a.	n.a.	3.25	F	manual	\$169
	Speed-Kut	16-19	gas	D	23	n.a.	n.a.	n.a.	3.5	D	manual	\$189
	Most-Kut	16-19-24	gas	G	26	n.a.	n.a.	n.a.	4	F	manual	\$189
	Speedemon	16-19	gas	D	n.a.	n.a.	n.a.	n.a.	3.5	D	semi-auto.	\$204
TERRILL	60	14-18-24	gas	D	28½	3½"	n.a.	6.45	n.a.	D	manual	\$235
TRAMS	125F	14-16-19-22	gas	D	22	flush	Power Prod.	n.a.	3.5	F	manual	\$165
	275D	14-16-19-22	gas	D	22	flush	Power Prod.	n.a.	3.5	D	manual	\$185
TREE FARMER	B	16-20	gas	D	23	flush	Power Prod.	4.7	3	F	semi-auto.	\$140
	BLP	16-20	gas	D	23	flush	Power Prod.	4.7	3	D	semi-auto.	\$160
	AL	20	gas	D	24	flush	Power Prod.	4.7	3	F	auto.	\$175
	ALP	20	gas	D	24	flush	Power Prod.	4.7	3	D	auto.	\$190
	AR5	20	gas	D	n.a.	flush	n.a.	n.a.	5	D	either	\$200
VON RUDEN	Hydra-Flex	18-27	(^f)	—	27 ^b	n.a.	Von Ruden	—	—	—	auto.	\$250 ^c

*Model has a 5-hp. clutch.

^bPrice for 20" size.

^cPrice for 16" size.

^fSaw has hydraulic motor, driven by a standard tractor power-take-off pump.

^bPrice for 27" size.

annoyance of that trailing electric cord.

What capacity? The kind* of wood you'll cut, and the amount, are determining factors. Don't expect electric saws priced under \$100 to cut more than an occasional piece of wood over half a foot in diameter, or the bigger electrics to consistently handle anything over a foot.

The best sellers in gas saws appear to

be those of 16" to 20" guide-bar lengths. In choosing, estimate the diameter of the largest log you are likely to saw regularly, and add another two inches to be safe. This gives the guide-bar size you need.

Direct or gear drive? On direct-drive saws the chain is driven by a sprocket that is clutch-coupled directly to the engine. Chain speeds run from about 2,000

to 4,000 feet per minute. On gear-drive saws, bevel or spur gears drop the chain speed to between 700 and 1,800 feet per minute.

With a given chain and horsepower, gear and direct-drive saws cut the same log in the same amount of time. Because of the slow chain speed on gear drives, there's less wear on both guide bar and chain. Gear-drive saws will also knuckle



PUSH-PULL BLADE on this gas-powered reciprocating Wright saw is designed to do same wood-cutting jobs as chain saw. Blade shuttles rapidly back and forth in slotted guide.

down and cut—if slowly—under difficult conditions, or with a dull chain.

On the other hand, cutting with a direct-drive saw is easier. Because two or three times as many teeth enter and leave the stock in a given time, they cut smoother and feed themselves through with little effort. Another advantage of the fast-moving chain is that it's able to cut at any point along the bar. You can reach out and trim branches with its end, undercut with its top, and even "bore" right through with the nose.

Carburetion. The two basic types are float and diaphragm. The float fuel system allows the saw to operate in two positions—horizontally, and on its right side. This arrangement takes care of felling and bucking, but may not be handy in notching, trimming and undercutting. The diaphragm system lets the saw run at full power in all positions.

Some saws are available with either system, the diaphragm carburetor adding from \$2 to \$15 to the price. If a choice is offered, be sure which type your quoted price includes.

Is starting convenient? Some gas saws have a tendency to do a quick flip when you pull on the recoil starter. Check on

this by actual trial. See also if the choke is easily reached.

Some makers equip their saws with throttle locks. By pushing a button, you lock the throttle partially open for easier starting. When shopping, it's wise to see if a saw with such a lock cracks the throttle—in locked position—fast enough to engage the centrifugal clutch and thus rotate the chain. If so, you could conceivably lock the throttle open any time you wished, a procedure about as safe as using a live rattlesnake for knot-tying practice.

How about lubrication? Chain oilers come in two general types, automatic and manual, with some manufacturers offering a combination. True automatic oilers meter oil to the chain whenever it is moving, regardless of saw position. Automatic oiling on a two-position saw may simply mean that oil is gravity-metered onto the chain. Manual oilers have plungers that you press to force oil into the guide-bar groove. If you choose manual oiling, be sure the plunger is conveniently located.

Chain-saw accessories. A bow-shaped chain guide called a plunge bow bar is the most popular optional accessory for chain saws. It eliminates a lot of bending and squatting when you're making low bucking and trim cuts. It will do any kind of job a regular chain bar can, except boring, but you'll find it somewhat less convenient for normal notching and felling. Post-hole diggers, all-purpose drills, and land-clearance saws are some of the other accessories available.

The final test. The best way to check saw features is to try out a model before you buy it. Many a dealer has a test log behind his store where you can get a good idea of power, weight, balance and convenience with a sample cut or two. (Remember that you'll be using the saw under less ideal conditions, and that lightness is a virtue appreciated at the end of a day's work.)

If you've never handled a chain saw before, it may be worthwhile to pick one up at a tool-rental service and try it out for a few hours before you start shopping. Regardless of the model, it will give you some basis for comparison and personal preference. Usual rental fees run about \$2 per hour or \$10 per day for electrics. Gas saws go for about \$3.50 per hour, or \$17.50 a day.

END



what's new

for your car

When one cell goes bad on the battery above, you just slip it off and hook on a new cell, saving the cost of buying a whole new battery. The interlocking plastic cells each supply two volts, can be joined side-to-side or end-to-end for any voltage and hook-up—series or parallel. Individual Auto-O-Cels cost about \$10 each.

New oil dipstick is made of metal that's said to attract combustion acids so they eat the stick instead of your engine. A magnet on the stick is said to remove metal particles. Two models, for engine crankcase and automatic transmissions, are sold by New Science Institute for \$3.95 each . . . New Mabry plastic lens attaches to the left headlight and bends the beam down to reduce glare.

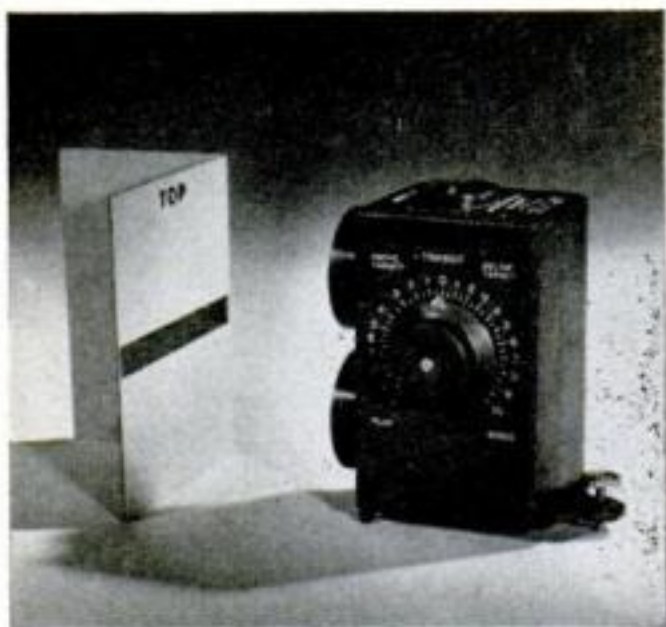
Stalled motorists will have no trouble stopping traffic if they're pretty girls, but men may have better luck with the flag at right. Good Samaritan League will supply one for \$2.



More new products on the next page

OCTOBER 1958 155

what's new for home improvement and upkeep



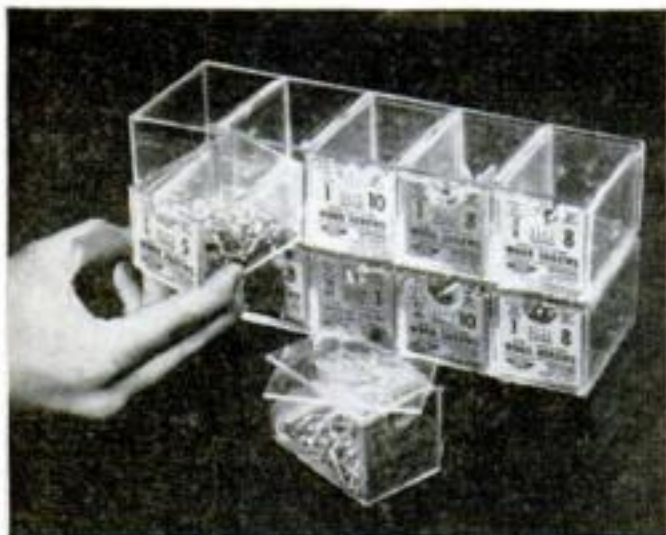
Want to level two walls or grade a terrace flat? The inexpensive transit at left uses a novel system of split-image mirrors to tell you how high one point is above another. You aim the transit at a black line on a metal target up to 300' away until the line produces a single image on both mirrors. A scale then shows you how many inches the target is above or below the transit. Hopkins sells the tool for \$6.95.

Tough, new plastic-impregnated wall covering comes in more than 140 "swank" patterns and colors, designed, its maker says, "to get washable wallpaper into the whole house, not just the kitchen." Rolls, sold by Birge, are 21' long, cost about \$3 to \$4 each . . . Good news for pollen sufferers: Portable, 15-pound electrostatic air cleaner, first of its kind, will be sold this fall by Coolerator for about \$60 . . . Philco's new line of '59 clothes washers, just announced, will use a unique direct drive, eliminating a gearbox and providing 600 washing actions per minute against 65 for previous types. Slimmed-down models will fit even a small bathroom.



Paintbrush attachment at left lets you spin-clean a solvent-dipped brush in any electric drill. Explorer Products makes the one shown; a similar one is also sold by Chemtor Products.

You can add a key-operated lock to any double-hung window with a plunger that mounts easily on top of the lower sash and engages holes in the upper one. Yale sells the lock for \$1.85 . . . Those hard-to-get ball-bearing hangers used on kids' swings and other equipment are now available from Wessel Hardware Corp.



Screws sold in midget plastic drawers, at left, make it easy to store supplies. The Elco boxes sell for 59 cents each, are available in five types and 40 sizes of screws.

LATE TIP-OFF: The horsepower race in outboards may be over. Evinrude's top model for '59 will be a refined—but not power-boosted—version of its '58 50-hp. V-four. It will feature extra-quiet operation and a low-battery-drain starter. Look for Johnson to stand pat, too.

for more information:

Here's where to write if you can't get any item listed above: Aut-O-Cel, Box 220, Des Moines, Iowa; BeeVel Products, 2249 Federal Ave., Los Angeles 64; Birge Co., 390 Niagara St., Buffalo, N. Y.; Chemtor Products, 32805 Northwestern Highway, Franklin, Mich.; Coolerator Div., McGraw-Edison, 5201 W. 65th St., Chicago; Elco Tool & Screw Corp., 1800 Broadway, Rockford, Ill.; Evinrude Motors, Milwaukee 16;

Explorer Products, Box 1958, Opa-Locka, Fla.; Good Samaritan League, 221 N. LaSalle St., Chicago 1; Hopkins Mfg. Co., Emporia, Kan.; Mabry Mfg. Co., Ellicott City, Md.; New Science Institute, 724 N. Lake St., Burbank 2, Cal.; Philco Corp., Philadelphia; Plierench Co. of America, 4611 N. Ravenswood Ave., Chicago 40; Sears, Roebuck, Chicago; Stanley Tools, 111 Elm St., New Britain, Conn.; Ungar Electric Tools, 4101 Redwood Ave., Los Angeles 66; Wessel Hardware Corp., 919-931 N. 5th St., Philadelphia; Yale & Towne Mfg. Co., Chrysler Bldg., NYC.



the latest in tools

Interchangeable jaws for the pliers above give you a choice of two sizes for gripping pipe, a wheeled tube cutter, wire bender, standard nut jaw, and a super-wide jaw that opens to 3"—all in one tool. The basic Plierench sells for \$8.50; extra jaws for \$1.50 to \$2 each.

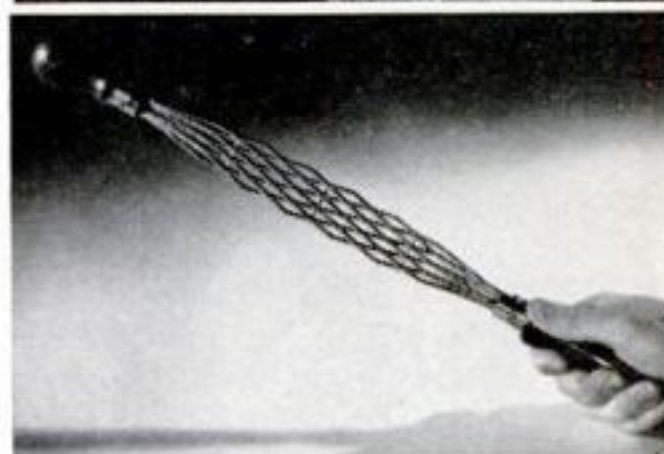
Latest attachment for Sears new 10" radial-arm saw, reported on in May PS, is a 2"-capacity jig-saw that's driven directly from the motor shaft. It sells for \$12.95.

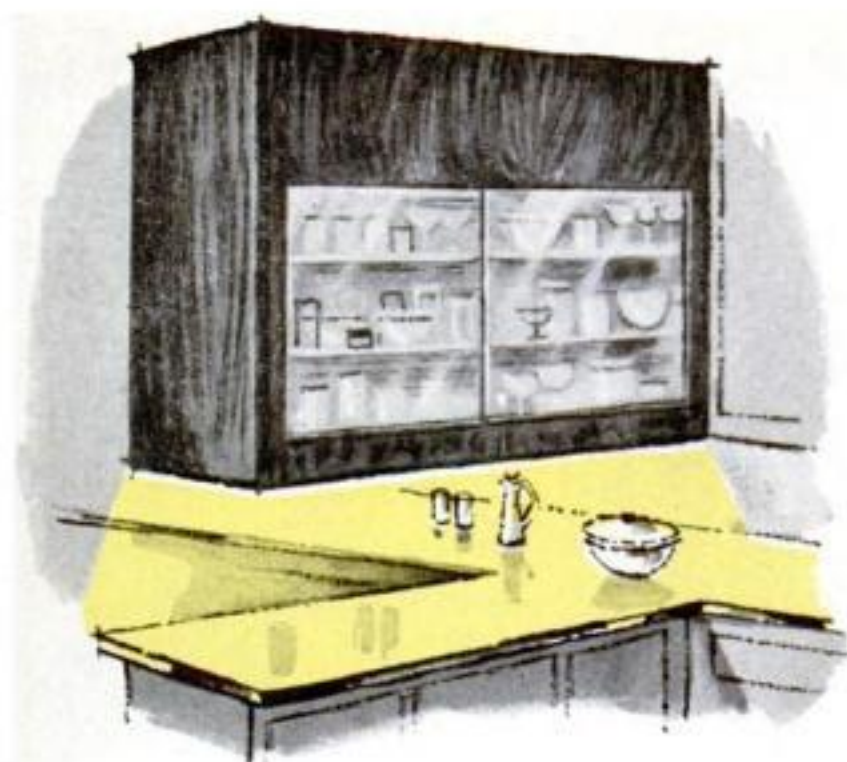
Three new soldering tips have been added to Ungar's line of soldering guns. The 2" straight and offset chisel tips, at top right, are both extra long for sneaking into deep spots. The needle-point tip at bottom is for extremely delicate jobs. All operate at up to 800°F.

LATE TIP-OFF: Stanley will announce an all-new router in the home-shop price class this fall. Another Stanley "first" is a slicked-up line of garden tools you'll be seeing soon.

New two-way rasp-file below at right shapes both wood and metal with a series of hacksaw-like blades spaced apart to keep the tool from clogging. One side provides coarse cutting teeth, the other side fine ones. Bee-Vel sells it for \$3.25.

Sheldon Gallager





**New
surface wiring
is a low-cost
way of**

Lighting Up the Kitchen Shadow Area

COUNTERS where food is prepared deserve the best lighting in a kitchen. But they don't always get it. Light from a central ceiling fixture is often blocked by wall cabinets; a housewife standing at a sink or counter often must work in her own shadow.

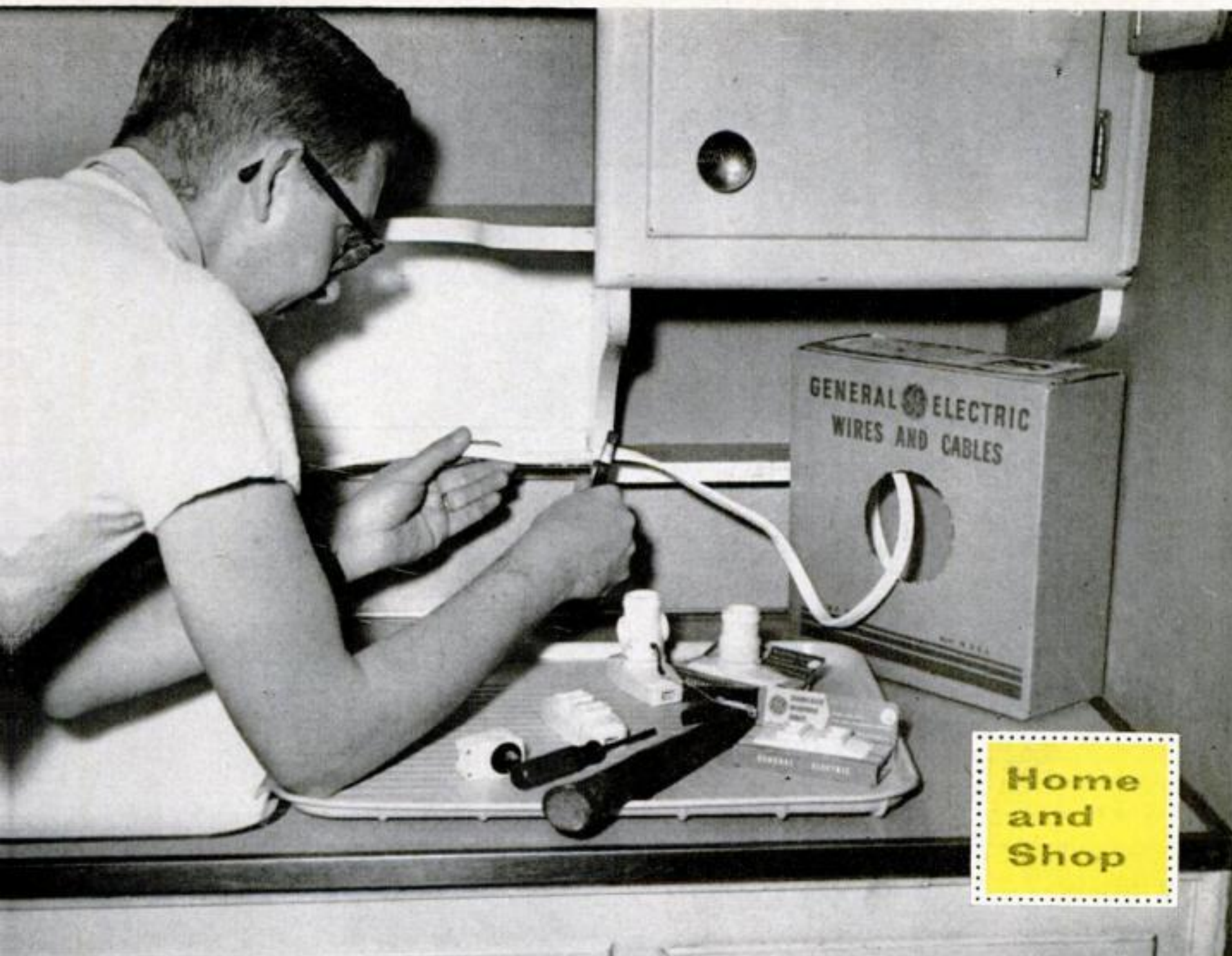
Lights hidden under the wall cabinets will illuminate these shadow areas. They supplement the main room lighting, but they can be used alone, too, when bright general illumination isn't needed.

New surface extension wiring that reached the market within the past year is made to order for adding this under-the-cabinet lighting inexpensively. You can make the installation yourself. Lamp sockets, receptacles and switches are

screwed to the wall and connected by special No. 12 nail-on-wire that simply plugs into an existing outlet.

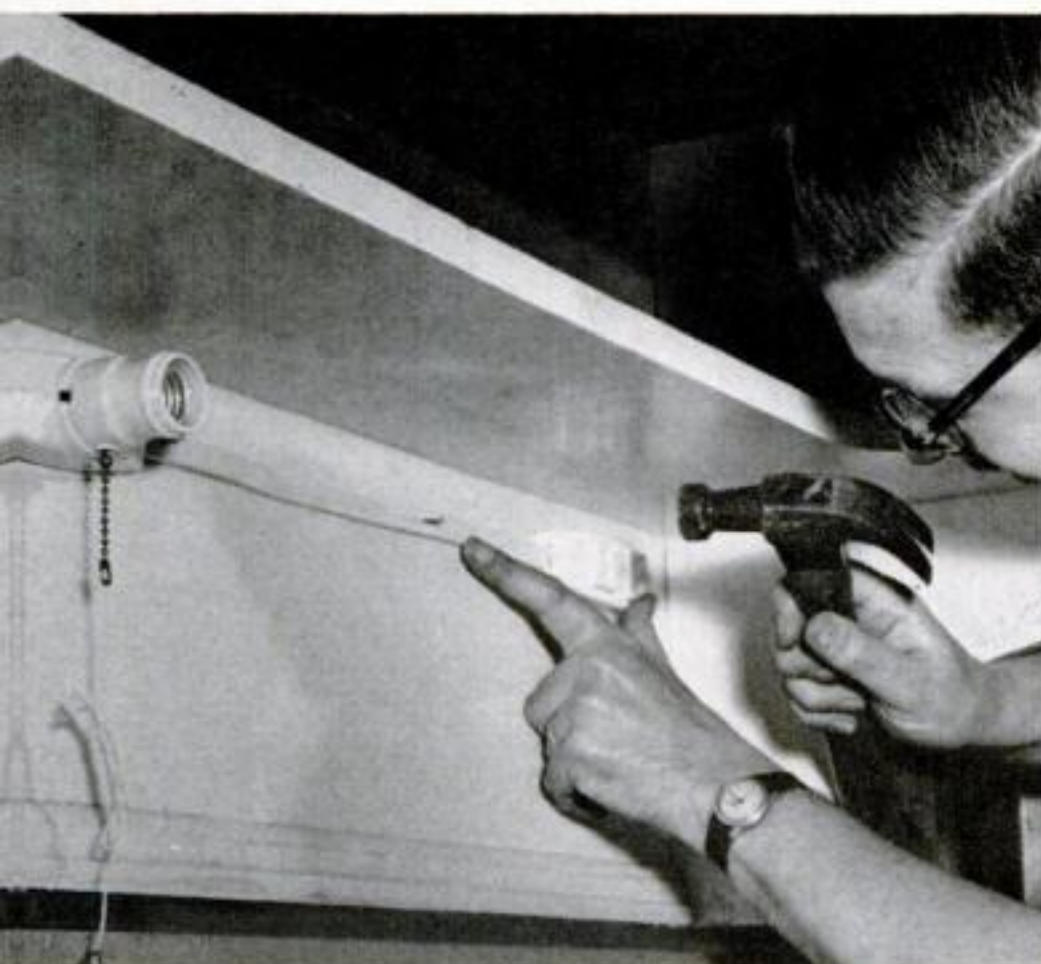
You can use the incandescent-lamp sockets that come with at least one make of surface wiring—or you can buy and install a fluorescent fixture, attaching it either to the bottom of the wall cabinet or to the wall at the rear of the counter. You may want to apply a suitable shade or shield to the lamp if a bare bulb is too bright.

As a bonus, while putting in the light, you can also hook in an extra outlet or so along the wall at the rear of the counter. Remember, though, that too many outlets will increase the chances of overloading the circuit.



YOU CAN CUT LENGTHS OF CABLE for GE surface extension wiring with pliers or knife. Cost of

adding two double outlets and pull-chain socket (above) was \$4.80, using six feet of wire.

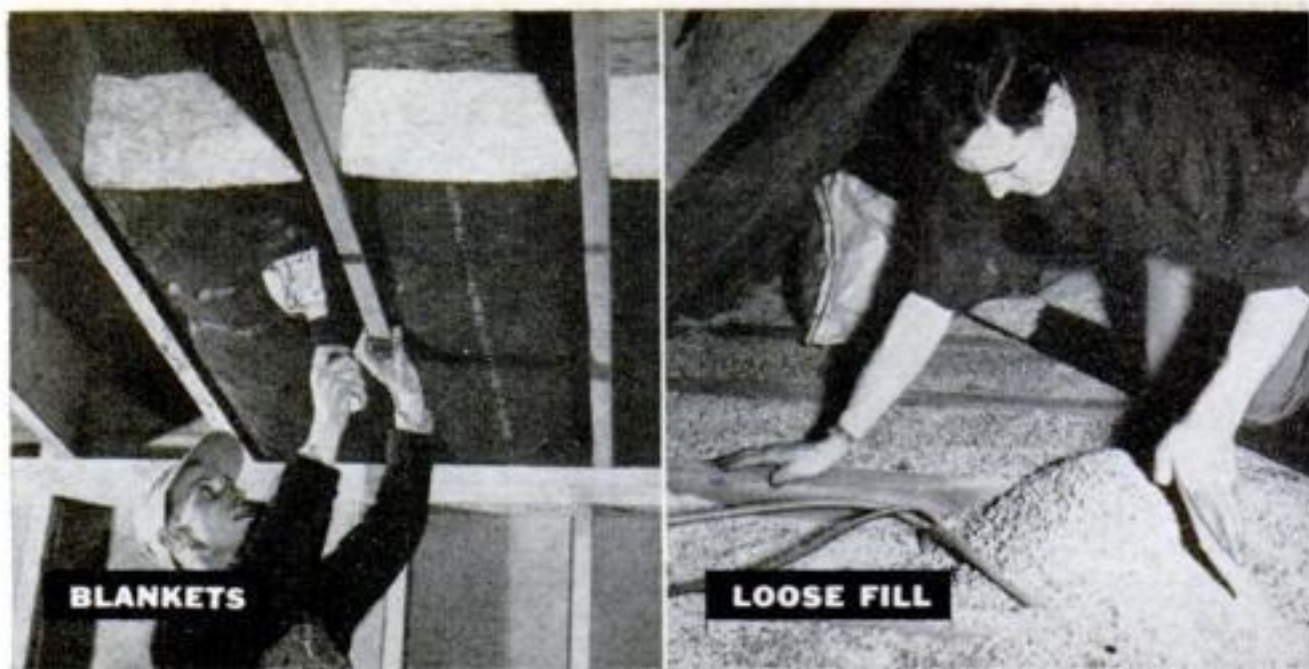


SPECIAL NO. 12 WIRE, covered with thick plastic, is nailed to the wall. Sockets and outlets have screwless connectors. To hook up, you simply shove in a stripped end of the wire.



COMPLETED EXTENSION plugs into any wall outlet. Wire costs about 20¢ a foot. Fittings—including outlets, lamp sockets, junction boxes and switches—range from 50¢ to \$1.15.

**Interested
in cutting your
heating bills?
Then you'll
want to know**



The Latest About

By A. M. Watkins

FOR years, home insulation has been like medicine: You know it's good for you, but swallowing the pill hasn't always been easy. Consciously or not, manufacturers' have succeeded in wrapping their wares in a bundle of question marks. Which insulation is the best for you? How much do you need? Where should you put it?

Now, for the first time, reports from scores of manufacturers answering a special POPULAR SCIENCE survey show that:

- Good insulation can do more to cut your heating bills than ever before. This is because fuel costs have skyrocketed 100 percent or more in the last decade, while insulation costs have gone up relatively little. Evidence: Recent tests of 172 guinea-pig houses show that proper insulation can reduce fuel costs for *both* winter heating and summer cooling to \$130 a year—about \$11 a month.

- New types of insulation have been especially developed to make it easier for you to choose and install the best kind to meet your own needs.

- Despite (or because of) the sugar-coating on the pill, there are still many misconceptions about insulation that need clearing up. For instance:

How to tell how much you get. Modern insulation comes in a perplexing variety: cotton, wood, paper and mineral blankets; loose fill that you just pour out of a bag; special metal foil that reflects heat; and many types of rigid panels.

All of these are basically good insulators, but some are better than others, or are better for a particular job.

How can you tell what's what?

All bulk insulation, such as batts and blankets, is rated for efficiency by a simple but little-known measurement called k factor. Some dealers may tell you they don't know what it is, or that it's too complicated for you to care about.

This is nonsense. K factor is simply the amount of heat—measured in BTUs per hour—that can escape through a slice of insulation 1" thick and a foot square. The lower the k factor, the less heat the insulation lets through. Brick, which is not an insulating material, has a whopping k factor of 4.5; cotton, a very good insulator, rates a miserly .24.

This doesn't mean that the insulation with the lowest k factor is always the best for you; it simply means that you may have to use twice or three times the thickness of one type to get the same insulating protection as with another type. The important points are:

- Never buy insulation without knowing its k factor or equivalent rating.

- Know how many inches of one type are equal to how many inches of another. You'll need 2" of a .48-rated material, for instance, to get the same insulating value as 1" of a .24-rated material.

- Plan ahead where the insulation will go. In walls, where space limits you to about 3" of thickness, you may want a low k factor; in ceilings, where you can usually pile on as much insulation as you



Home Insulation

want, the k factor may be less important, especially if the type you choose is cheaper or has other special advantages.

The accompanying chart shows k factors for most common types of insulation. The factors range from about .24 up to .50. Materials having k factors above .50 are not considered true insulation.

How much do you need? Manufacturers are fond of the saying: "The best insulation is the most insulation." Within practical limits, experts agree that every inch you add will cut your fuel bill.

A good yardstick that is rapidly gaining nationwide acceptance is the 6-3-2 rule. This means at least 6" of insulation under your roof, 3" in walls and 2" under a floor that's over an unheated crawl space.

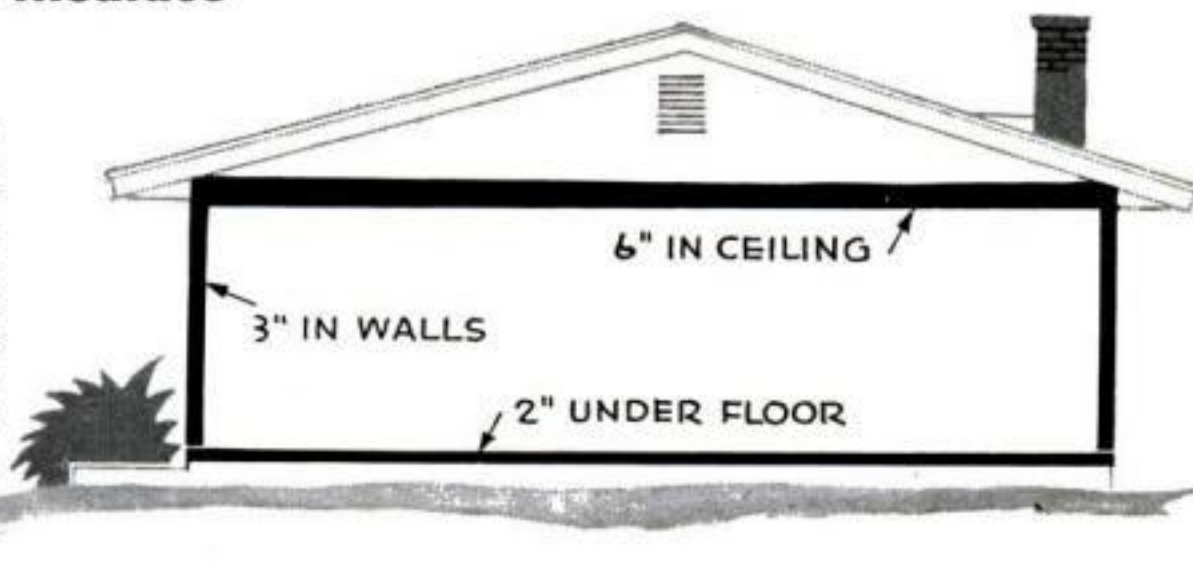
The super-thick 6" ceiling insulation that you'll be seeing this year has been developed especially for houses with summer air conditioning—which requires more insulation to keep heat out than your furnace does to keep it in—and for houses with electric heat, which requires extra-heavy insulation.

Such hefty insulation may not pay off, however, in all houses, particularly if your problem is mainly winter warmth, not summer cooling. In this case, the minimum recommendation is a compromise 3-2-2 formula (3" in ceilings, 2" in walls, 2" in floors). Both formulas are based on insulation with low k factors of .25 to .30. If you use higher-rated types, you must increase the amount you use.

Watch out for catch-phrases. Some

Why it's important to insulate the whole house

NEW 6-3-2 FORMULA is beefed up for year-round comfort because of modern-day oddity—air conditioning needs more insulation to keep house cool in summer than heating requires in winter. Rule calls for hefty 6" thickness in ceiling, 3" in walls, 2" under unheated floor.



Facts About the Five



1 BLANKET


	COTTON	WOOD FIBER	MINERAL WOOL
	Chemically treated to resist fire, rot and vermin. Comes with or without a vapor barrier, is generally the cheapest type of blanket insulation.	Treated wood fiber wrapped in paper. Some types come with vapor barrier or foil on one side, paper on the other.	Includes rockwool, glasswool and glass fiber. Has good natural resistance to fire, vermin and decay. Most brands come with built-in vapor barrier. Is one of most popular types used.
K FACTOR*	.24 to .26	.25 to .27	.27
SIZES	Sold in rolls up to 100' long and in widths from 15" to 23" to fit between studs, joists and roof rafters. Vapor-barrier type is always installed with barrier facing warm inside of house. Thickness ranges from 1" to 4" for cotton and wood fiber, up to 6" for mineral wool. Precut batts up to 8' long also available in some types.		
COST	5¢ to 8¢ per square foot	6¢ to 12½¢ per square foot	2½¢ to 14¢ per square foot



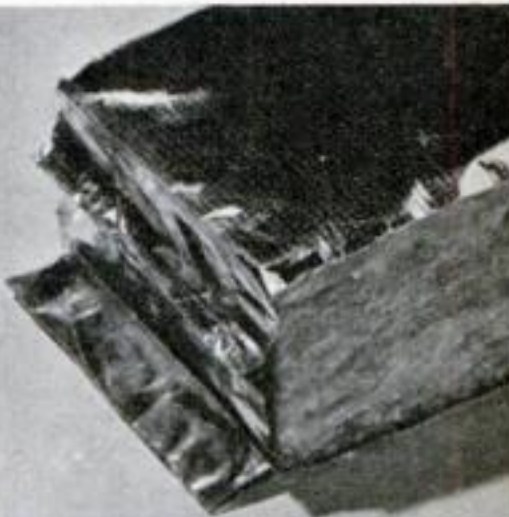
2 LOOSE FILL

	MINERAL WOOL	CELLULOSE FIBER	AGGREGATE
	Same material as in regular mineral-wool blanket, but comes loose in bags for pouring or blowing in existing houses. Is one of least costly types, but does not include vapor barrier so use of separate barrier is desirable.	Includes wood fiber (chiefly redwood bark) and shredded newsprint, treated to resist fire and vermin. Is used in same way as mineral wool and other loose fills, but is usually slightly cheaper. Does not include a vapor barrier.	Very lightweight sandlike volcanic mineral or expanded mica. Main types are perlite and vermiculite. Has good natural resistance to fire, vermin and decay, will not pack and settle. Does not include a vapor barrier.
K FACTOR	.30	.28 to .30	.34 to .48
SIZES	Usually comes in four-cubic-foot bags, which can be spread to any desired thickness between ceiling joists or poured between wall studs. Average use is 3" in walls, up to 6" in ceilings. Higher k factors of aggregate fills may require the use of somewhat greater thicknesses than with other fills in order to obtain the same insulating value.		
COST	About \$1.50 to \$1.75 for each four-cubic-foot bag, or 3¢ to 10¢ per square foot depending on type and thickness used.		

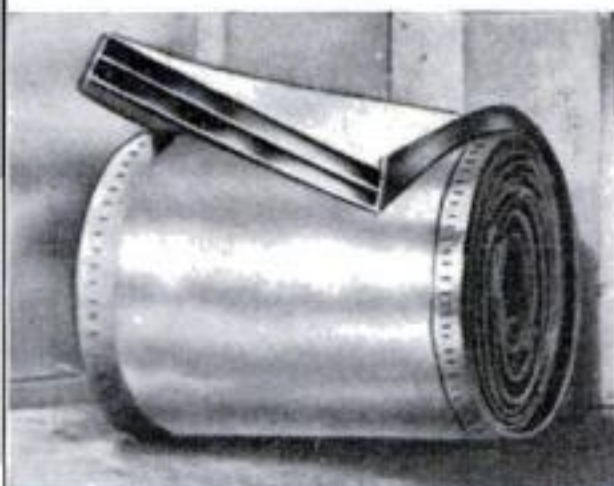
Basic Types of Insulation

		CELLULAR SLABS	INSULATING BOARD
		Stiff sheets of cellular glass or foam plastic, used mainly on masonry walls and around slab floors. All have good natural resistance to decay and vermin; some provide built-in vapor barrier.	Strong, wood-fiber board in many types for sheathing, roof decking and interior paneling. Very good for extra insulation, or for use in mild climates, but is not generally adequate by itself for cold climates.
3 RIGID			
	K FACTOR	.27 to .29	.33 to .38
	SIZES	Comes 1" or 2" thick in blocks and strips of various sizes for special jobs.	Comes ½" to 1" thick in sheets, planks and small tiles for interior paneling; up to 2" thick for wall and roof sheathing; up to 3" thick for roof decking.
	COST	About 13½¢ to 26½¢ per sq. ft.	Interior panels: 6¢ to 20¢. Sheathing, decking: 20¢ to 65¢.

FOIL-WRAPPED BLANKET	
Same as regular blanket insulation, but has aluminum foil on outside. Best used in attic or roof, especially where important to reflect sun heat in summer. Comes in cotton, wood-fiber and mineral-wool types. All have vapor barrier.	
K FACTOR	.24 to .27
SIZES	Same as for regular blankets, but is usually limited in thickness to 1", 2" or 3".
COST	7¢ to 14¢ per square foot.

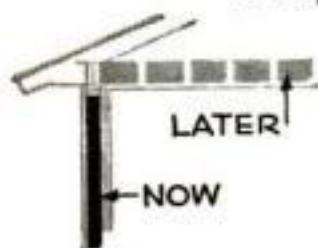


4 COMBINATION

		SINGLE-LAYER FOIL	MULTIPLE-LAYER FOIL
		One sheet of aluminum foil; or, in some cases, aluminum-coated paper, which is 25 to 50 percent less reflective than foil. Best used as vapor barrier or under roof to reflect sun heat, but is not adequate by itself for winter insulation.	Comes with from two to eight layers of aluminum foil with air spaces in between. Recommended use in cold climates: at least three-layer type in walls, four-layer type in ceilings. Is especially good for stopping summer heat as well as cold.
5 REFLECTIVE		(Not rated by k factor; see explanation in text)	
	SIZES	Available in rolls and batts like blanket insulation and in same widths to fit between studs and joists. Foil layers come flattened, must be pulled apart to expand air spaces.	
	COST	About 3¢ per square foot	4¢ to 15¢ per square foot

square foot of insulation 1" thick. The lower the k factor, the better the insulation.

8 tips from professional installers to help you get the most

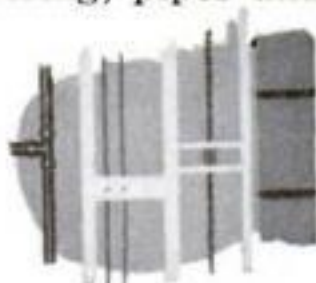


at once they're closed in. Ceilings and roof can usually be reached later through attic, and underside of floors from the basement.

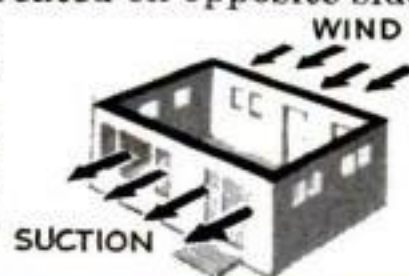
2. Always install insulation so vapor-barrier side faces inward to block moisture from the house. It's sometimes easy to reverse it by accident. When using loose fill, which does not provide a vapor barrier, it's best to install a separate barrier first.



3. You can keep damaging holes from being torn in insulation if you make sure that all wiring, pipes and ducts are put in first. If small rips do occur, tape them tightly to provide an unbroken seal. This is especially important on vapor-barrier insulation.



4. It's not true that sheltered walls need less insulation than those exposed to direct winds. Suction effect created on opposite side of the house draws out as much heat as is lost on nonsheltered side. For maximum protection, all walls should be insulated equally.



insulation is sold as "standard-thick," "double-thick," or "full-thick." These terms are largely eyewash. The so-called standard-thick may be only 1". Double-thick is double all right—a mere 2". "Full-thick" is anybody's guess.

Be sure that insulation is specified in actual inches; if it isn't, measure it.

What about reflective insulation? Aluminum foil is fast growing in popularity, but is still widely misunderstood. Since it consists of one or more layers of foil separated by air spaces, its size is measured not so much by thickness as by the number of layers it contains. It is also the one type of insulation that is *not* rated by k factor, as is bulk insulation.

This needn't throw you. It's fairly easy to tell how many layers of foil are equal to how many inches of bulk insulation. Estimates vary, but roughly:

Single-layer foil is equal to 1/2" of mineral-wool blanket (.27 k factor) in winter, up to 1 1/2" to 2" in summer; two-layer foil from 1 1/4" in winter, up to 3" to 5" in summer; three-layer foil from 2 1/2" in winter, up to 4" to 6 3/4" in summer. Types with up to eight layers are said to equal as much as 9" in summer.

Already you can see that foil is funny stuff. Its effectiveness jumps sharply from winter to summer. This is because it's at its best bouncing back radiant sun

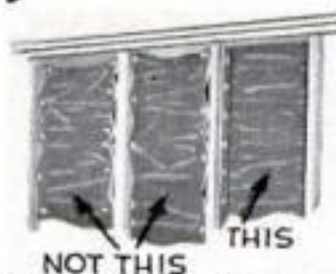
heat—in fact, it's two to three times better at keeping summer heat out than keeping winter heat in. It is also more effective under a roof than in walls because the roof bears the biggest share of the sun load.

Nevertheless—and contrary to a widespread misconception—reflective foil can be just as good in winter as any other insulation *provided* you use enough layers.

The correct installation of multiple foil is also of vital importance. Many people go wrong here. There are many sad stories about workers—pros, mind you—who have put multiple foil in a house exactly as it came out of the carton. It is usually shipped in compressed, tightly packed rolls. On unpacking, the multiple layers must be pulled apart like an accordion. This gives you the necessary air spaces between each layer. Without this, the foil does you virtually no good. Another thing: Foil insulation should not be laid flush over your ceiling. It should be suspended at least 3/4" above the ceiling surface so you get an air space.

What is combination insulation? This is one of the newest types to hit the market and is designed to combine the best advantages of bulk insulation with those of reflective foil. For many, it can be a real problem-solver, but you should know all about it before you buy.

for your insulation dollar



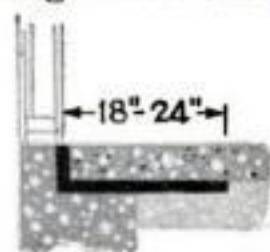
Adjoining edges of vapor barrier should overlap slightly to form continuous seal. Fill gaps around pipes with wads of insulation.

5. Fasten insulation tightly to studs or joists, spacing staples no more than 6" apart. If loose, it will open up gaps, later sag.

6. Air space above insulation is important to permit ventilation and prevent buildup of heat under the roof. In attic, carry insulation only up to horizontal collar beams, then run it across beams and down the other side. (You may need to add extra beams.)



7. Slab floors lose heat at the edges unless you insulate them. Insulation can be L-shaped, as at right, running down the sides, then 18" to 24" underneath; or you can run it straight down sides at least 12" deep. Minimum thickness is 1"; 2" is better.



8. Hold the palm of your hand against a wall to tell if you need insulation. In winter, outside walls should feel no colder than interior partitions, or they are losing valuable heat. Walls in existing houses can have insulation blown into them.

On the inside, it's the same as standard blanket insulation. Its outside, however, is wrapped in shiny aluminum foil. Like regular reflective insulation, the foil is at its best bouncing back sun heat. In summer, a 3"-thick blanket of combination insulation will actually give you the equivalent of about 5" to 5½" of bulk insulation.

In winter, however, the inside material takes over the brunt of the work and the foil just hitchhikes like a fifth wheel. It does you little good in roofs and adds only about an extra ½" in walls (provided it has an air space).

Combination insulation is a good bet for hot southern climates where you want summer cooling, or where you are cramped and want as much insulation as you can get in a small space. In cold climates, however, the new 6"-thick regular blanket insulation is likely to be top choice. It costs about the same as 3" combination insulation but is somewhat better at holding in winter heat.

Why insulate the whole house? Occasionally you'll hear the old argument that you can ignore your walls as long as you put insulation in the ceiling. This makes no more sense than bundling up in a bear-skin cap and scarf, then going out without an overcoat. Total wall area is as great or greater than roof area, especially

in a two-story house—and that adds up to a lot of heat loss.

The roof does, however, require thicker insulation because heat rises against it in winter and pounds down on top in summer. Also recent tests at Penn State University show that insulation works 25 to 50 percent better in a well-ventilated attic in summer than in one that is closed off and stifling hot.

In concrete-slab houses, a surprising amount of heat is lost through the edges of the slab. This can be prevented by rimming the entire slab, like a picture frame, with strips of rigid insulation.

Do you need a vapor barrier? It's advisable. Insulation, like gunpowder, is only good when it's dry. Heat passes quickly through wet insulation, just as it does when you pick up a hot pan with a wet pot-holder. A vapor barrier also helps to keep moisture from causing rot.

Today, you can buy most types of insulation with a built-in vapor-barrier liner, or you can install a separate liner first.

A good insulation should also be resistant to fire, vermin and decay. The organic insulations like cotton, wood fiber and paper are chemically treated for protection. The metal and mineral insulations are by their nature bug-proof and fire-resistant.

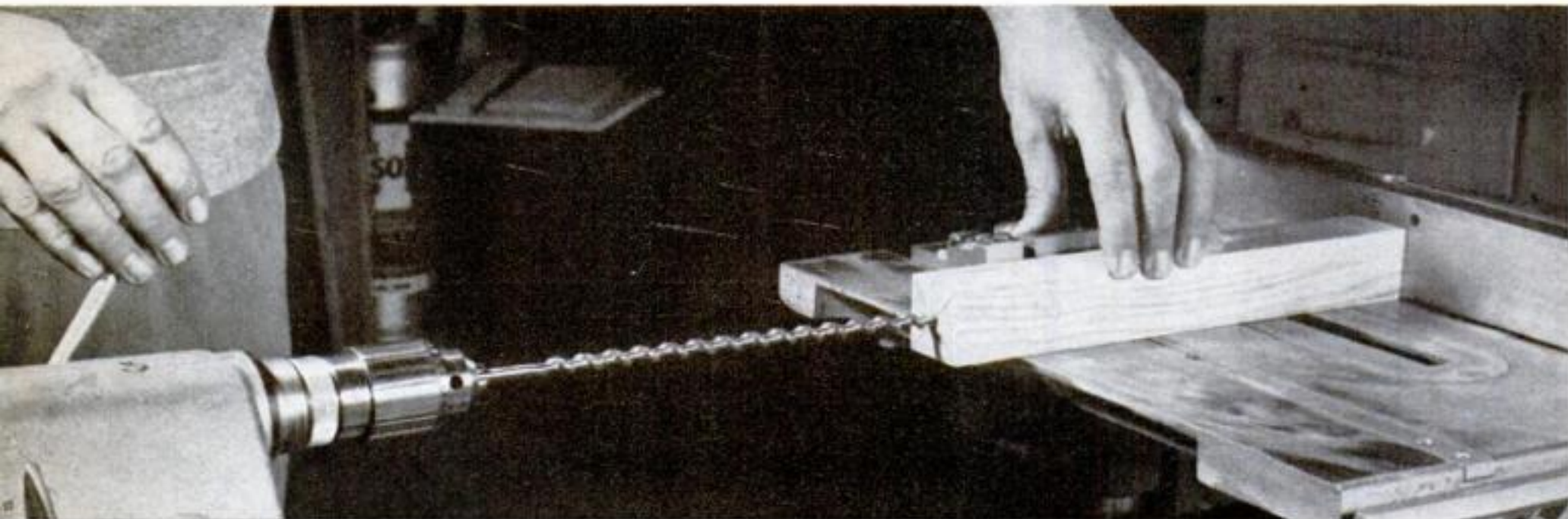
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5 Ways to Drill Deep Holes

Need to drill a hole beyond the depth of an ordinary bit?

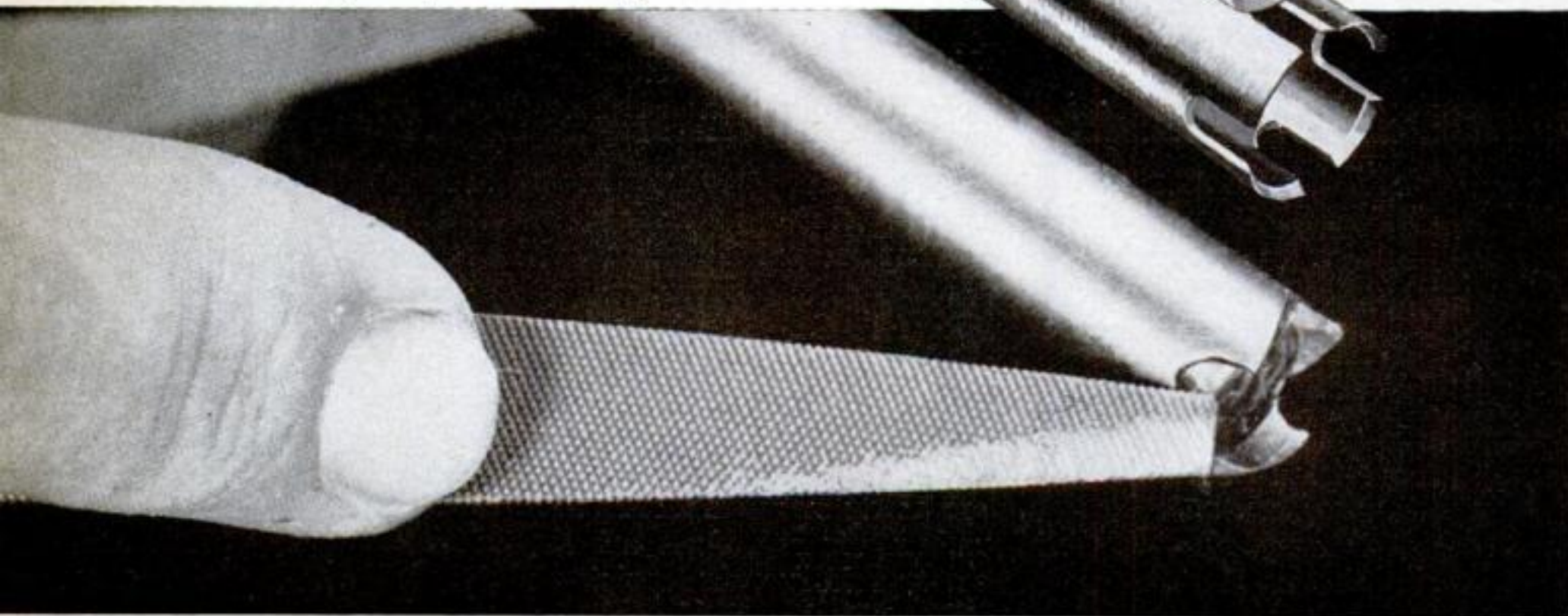
For concealed wiring in a lamp, say—or to run an axle through Junior's wagon? You can—these five simple ways

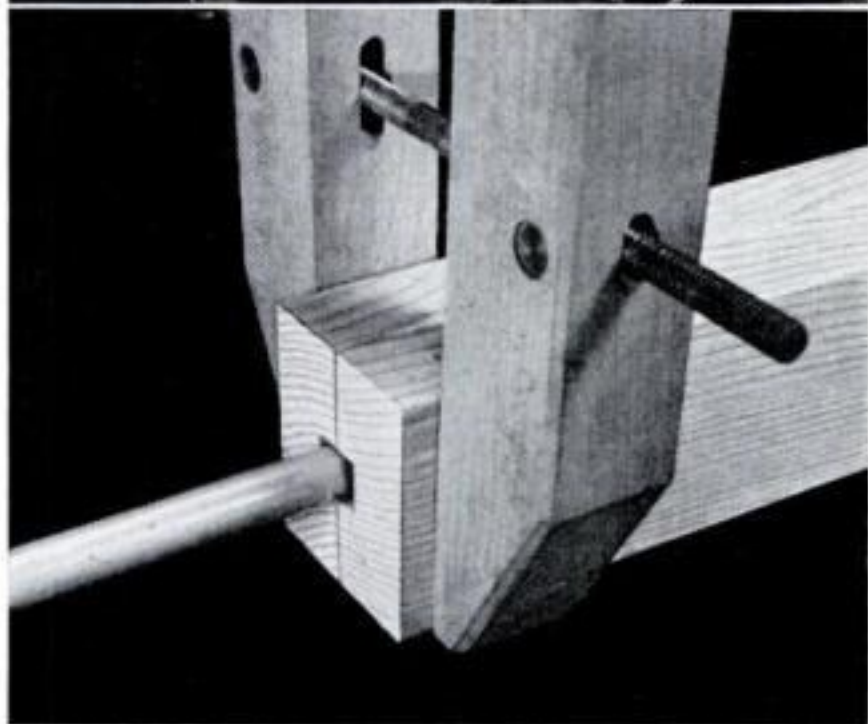
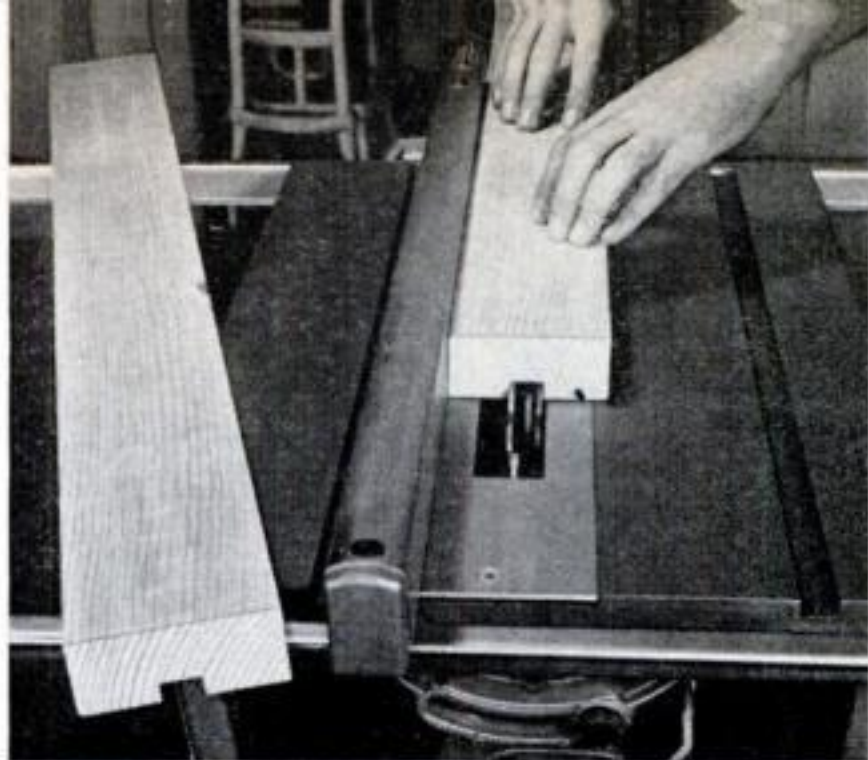
By R. J. De Cristoforo



1 USING EXTENSION BITS greatly increases capacity of drill press or multipurpose shop tool. Because quill stroke on both tools is limited, the table must be advanced each time the drill "bottoms." Always start extension bits at slow speed; otherwise they'll whip.

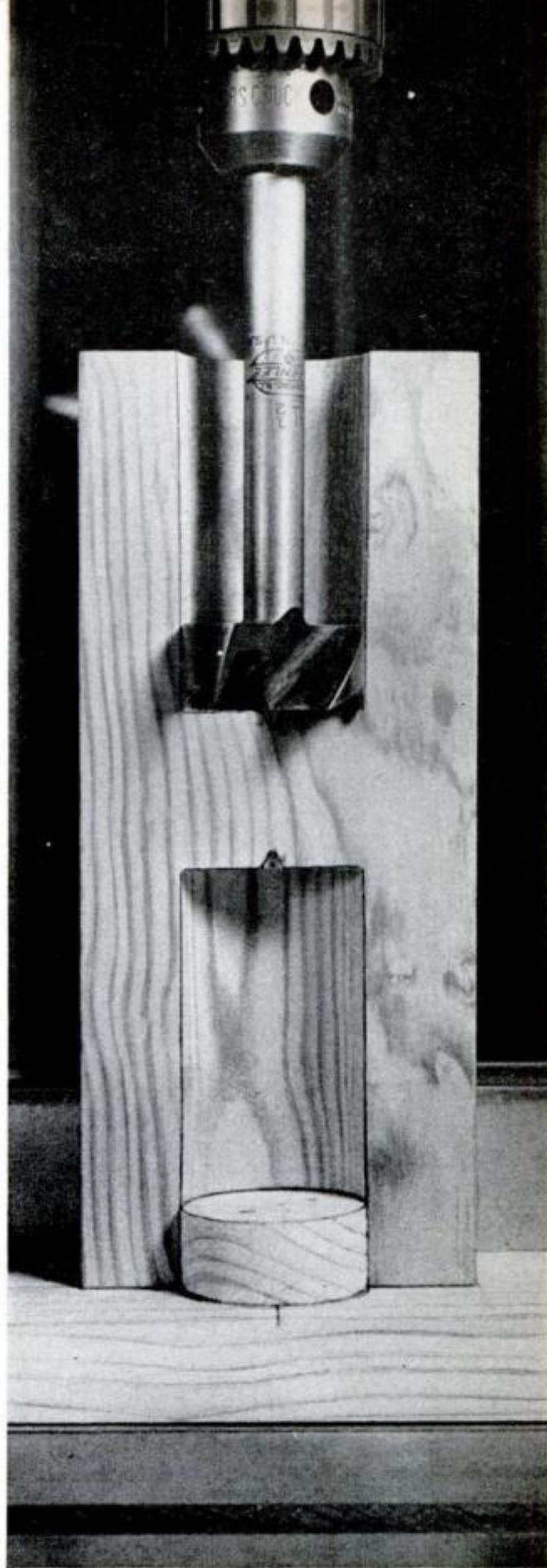
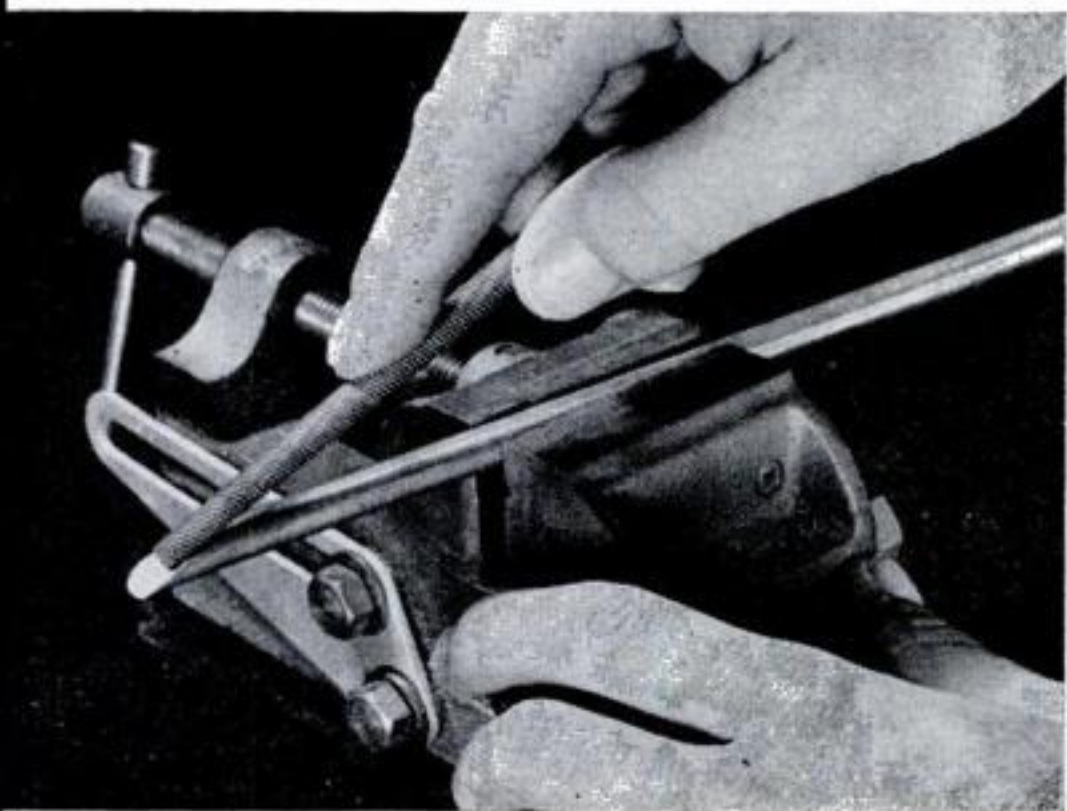
2 PLUG-CUTTING-TYPE DRILL, made from thin-walled steel tubing, is a good substitute for an extension bit. Countersink one end to form beveled lip, then saw and file to shape teeth. Remove burrs, and wax the tube before using. Retract frequently while drilling.





3 MATCHED DADOES provide a square center hole of any length, when they're cut in mating faces of stock sections to be glued together. To turn a post made this way, drive plugs into the ends of the hole. Once the work is removed from the lathe, the plugs are drilled out.

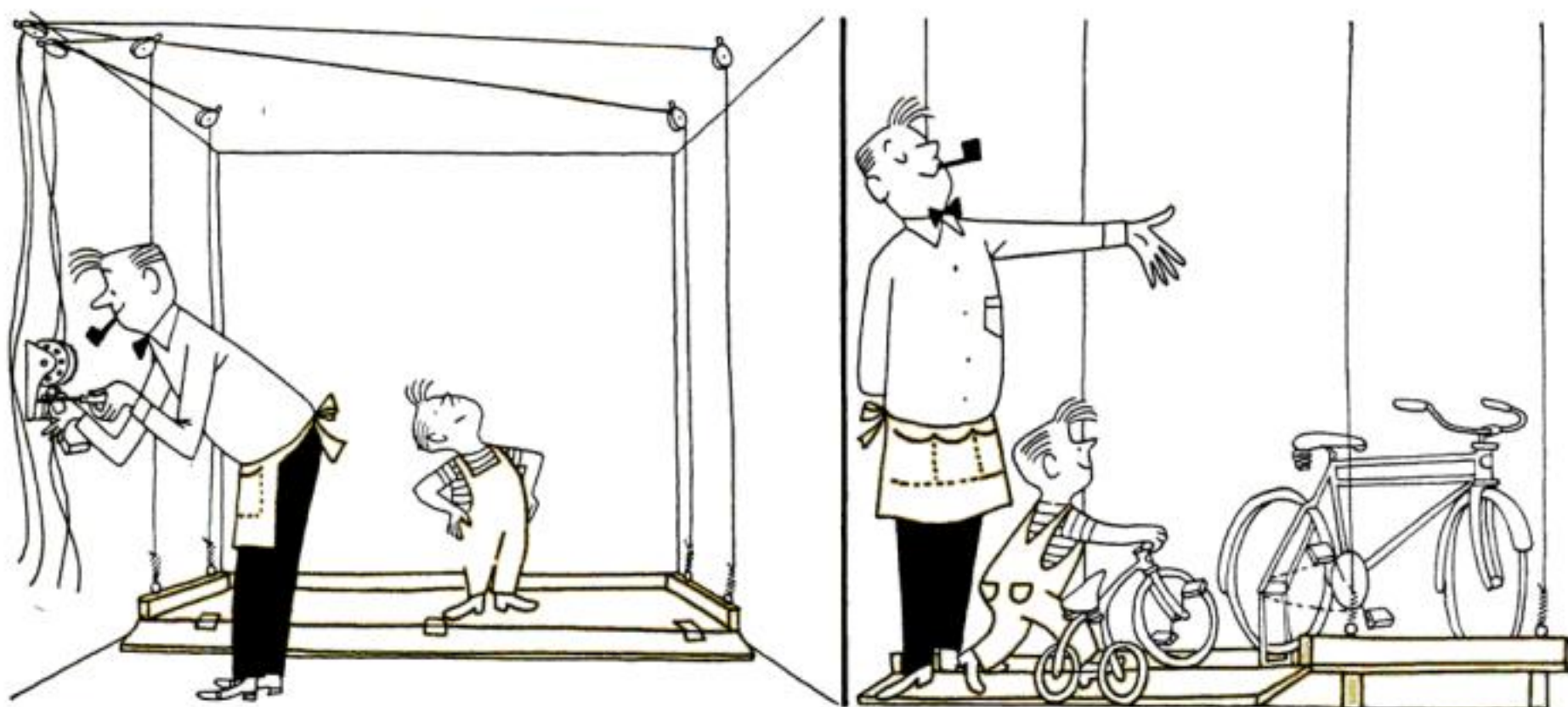
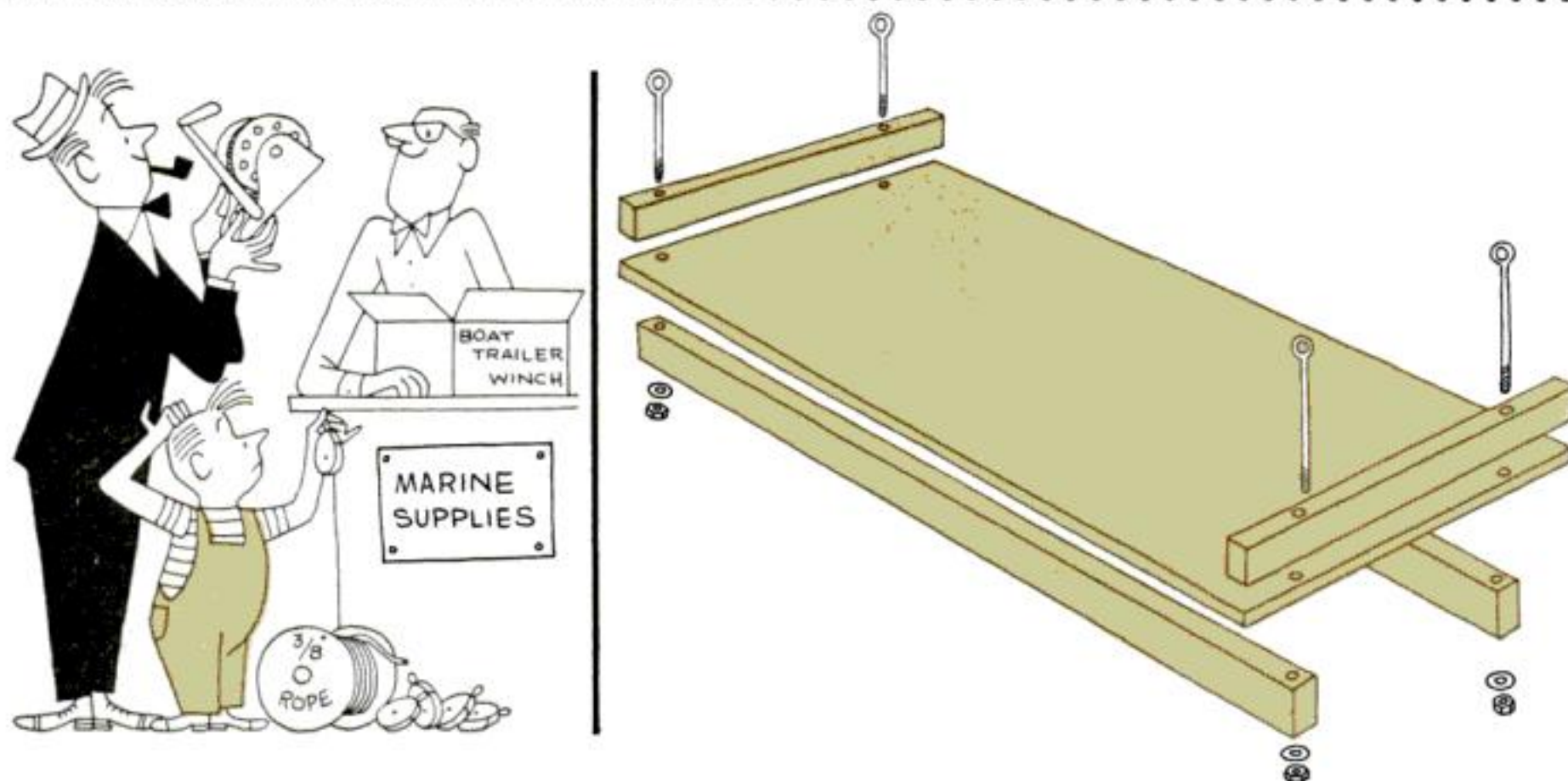
4 BIT SHAPED FROM DRILL ROD does more burning than cutting, but where fine-quality drilling isn't important, it works well. Cut the rod end diagonally and then file the diagonal face concave. Never start holes with a drill-rod bit; use it only to extend them.

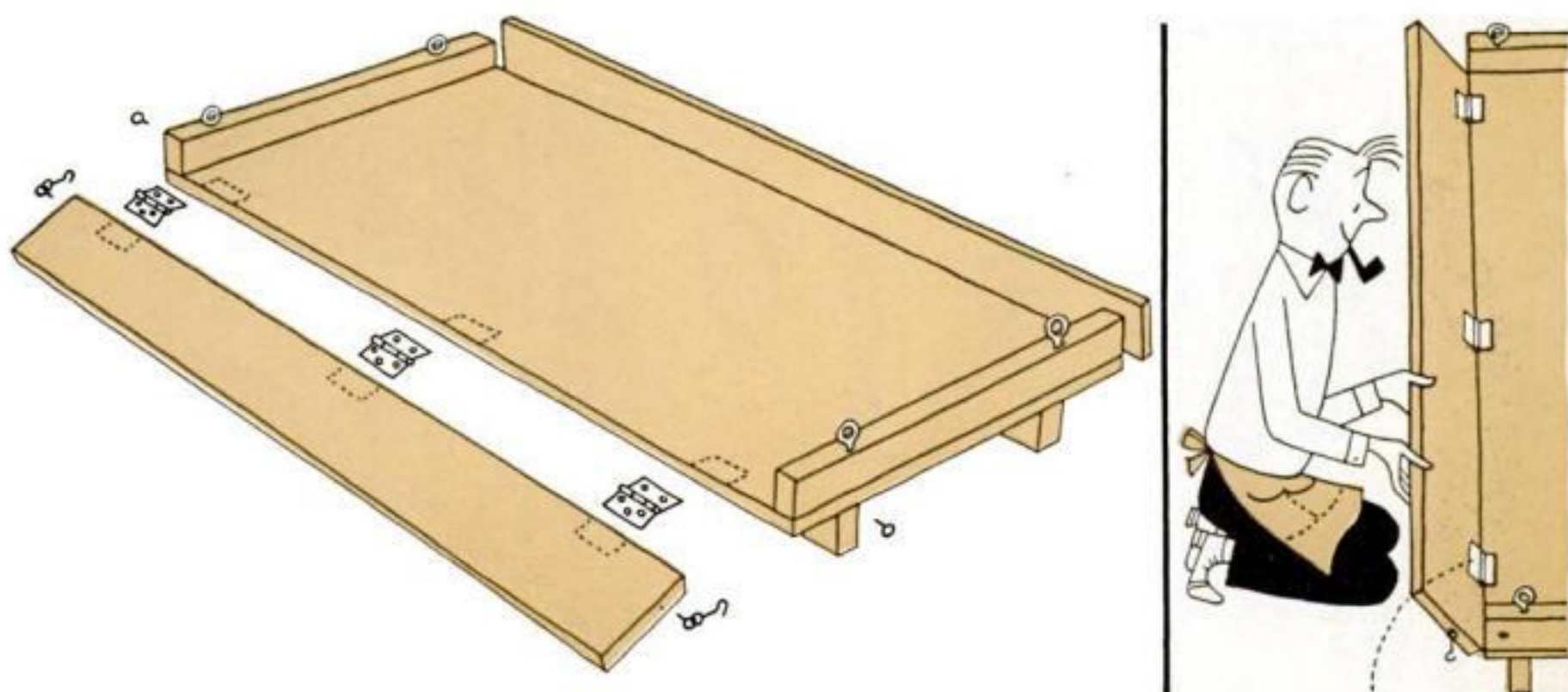
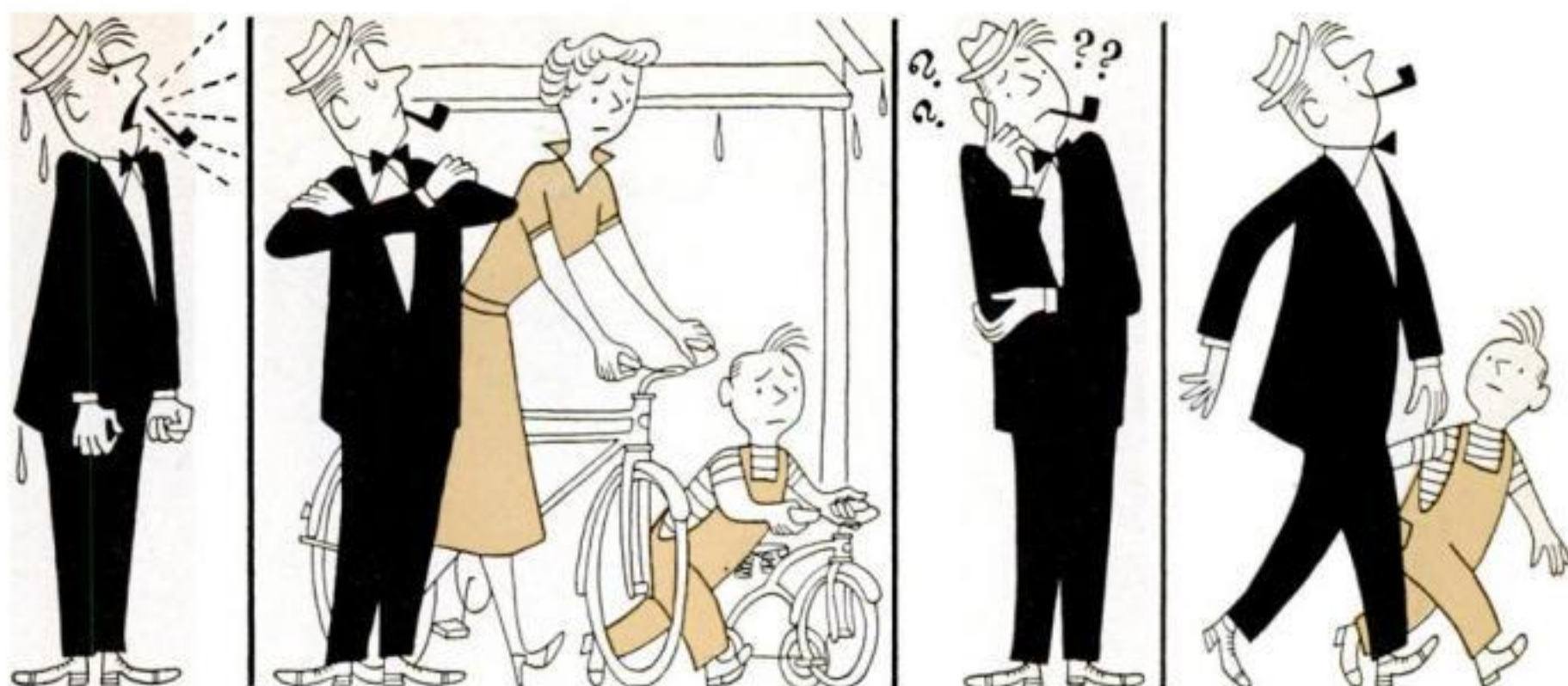


5 DRILLING FROM OPPOSITE ENDS of the stock doubles bit capacity. If the work is done with a drill press, use a jig with a plug the diameter of the hole to align the stock with the spindle and hold it steady for the second drill hole. Stock ends must be accurately squared.

Wordless Workshop

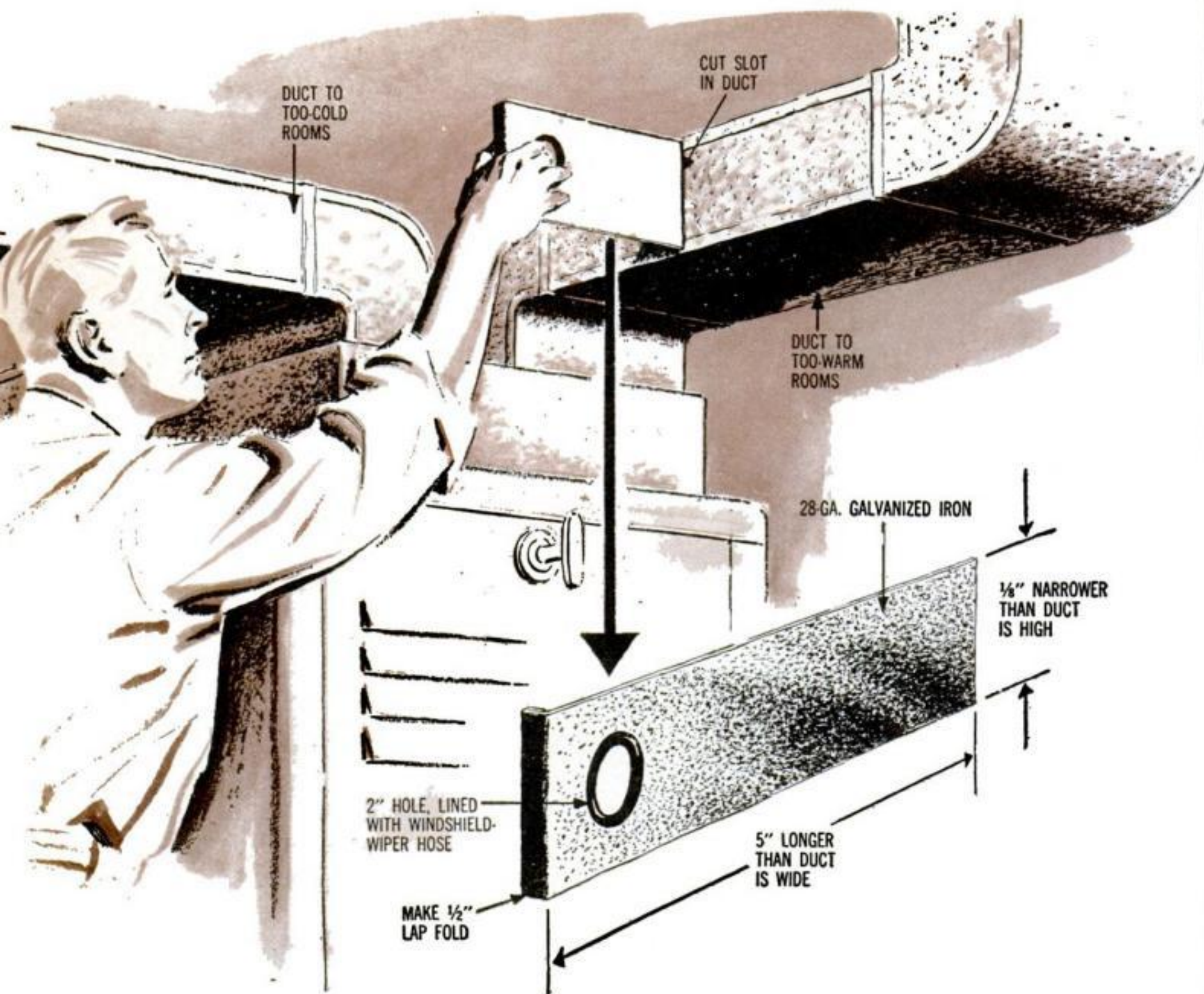
By Roy Doty and
Herbert R. Pfister





Next Month: A handy bottle caddy to carry milk indoors safely

OCTOBER 1958 169



How I Send House Heat Where I Want It

FORCED-AIR heating systems don't always provide the right amount of heat where it'll do the most good. Closing the register doors in overheated rooms helps some. But it's an inefficient way to divert warm air to cold areas. Too much heat still flows into the dead-ended ducts.

Faced with this problem, I found an effective solution—a sliding panel, or baffle, inserted in each overheated duct close to the furnace bonnet.

Making and installing the baffles was easy. First I traced the ductwork to find out which pipes went where. After locating the ones that ran to the overheated

rooms, I scribed a vertical line on one side of each of them. At the top of each line I punched through the metal with a small, sharp chisel. Then I extended the cuts to the bottoms of the ducts with a hacksaw blade (wrapping one end with friction tape gave me a temporary handle). To smooth the edges of the slots I used a fine-toothed file.

I made the baffles as shown in the detail drawing. The lip and rubber-lined hole at the outer end provide a convenient grip. Before inserting the baffles I dusted their edges lightly with powdered graphite.—*Herb Carrier, Detroit.*

How to Use a Hacksaw

know-how
file

WITH the right blade and proper use, a hacksaw makes light work of cutting through plastics, non-ferrous metals, iron, steel and even stone.

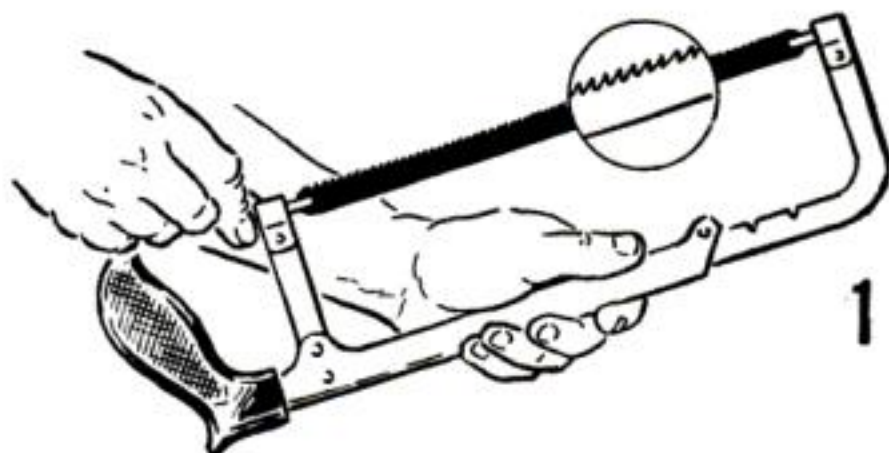
Be sure to use the blade intended for the job. Choose one with 14 teeth to the inch to cut 1" or thicker cast iron, steel, copper, bronze, aluminum or slate. Use 18 teeth for $\frac{1}{4}$ " to 1" sections of the same materials. Twenty-four teeth are right for $\frac{1}{8}$ " to $\frac{1}{4}$ " iron and steel, brass and copper tubing, wrought-iron pipe, drill rod, conduit and metal trim. When sections are $\frac{1}{8}$ " or thinner, 32 teeth are best. If you do a good bit of ferrous-metal hacksawing, you'll find it worthwhile to pay a little extra for special alloy-steel blades, which cut faster and hold up longer than ordinary blades.

Place the blade in the saw, teeth forward. It can be either in normal position in relation to the frame, or angled 90 degrees to meet special clearance problems.

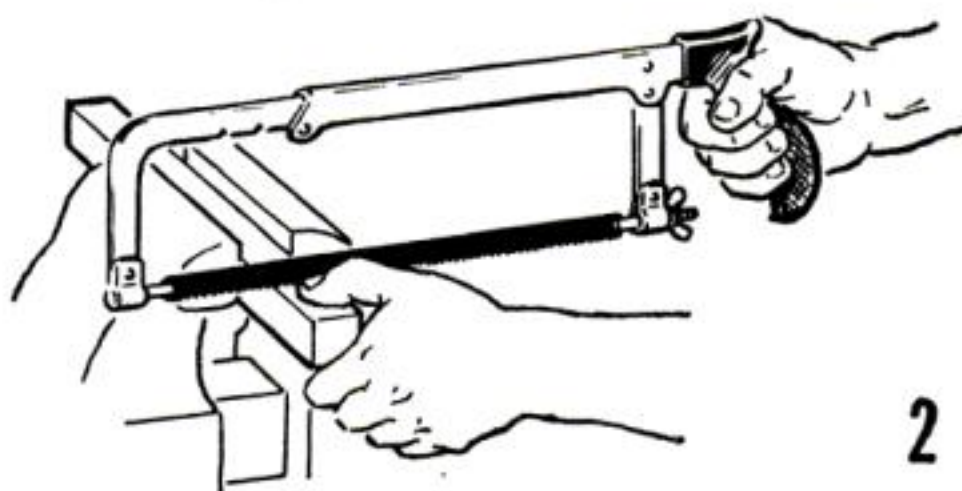
Then tighten the blade (Drawing 1) until it gives a "pinging" sound when picked with your thumb. After a few cuts it will stretch a bit, so give it another turn of the screw.

To start an accurate cut, use your thumb as a guide, sawing slowly with short strokes (2). As the cut deepens, shift your hand to the front of the frame and equalize pressure at both ends of the saw. Apply this pressure firmly downward on forward strokes, and lift up slightly on back strokes (3). While sawing, stand with your feet at least 12" apart and flex your knees in line with the strokes to add a slight body sway to your arm motion (4). A good cutting speed is 50 strokes a minute.

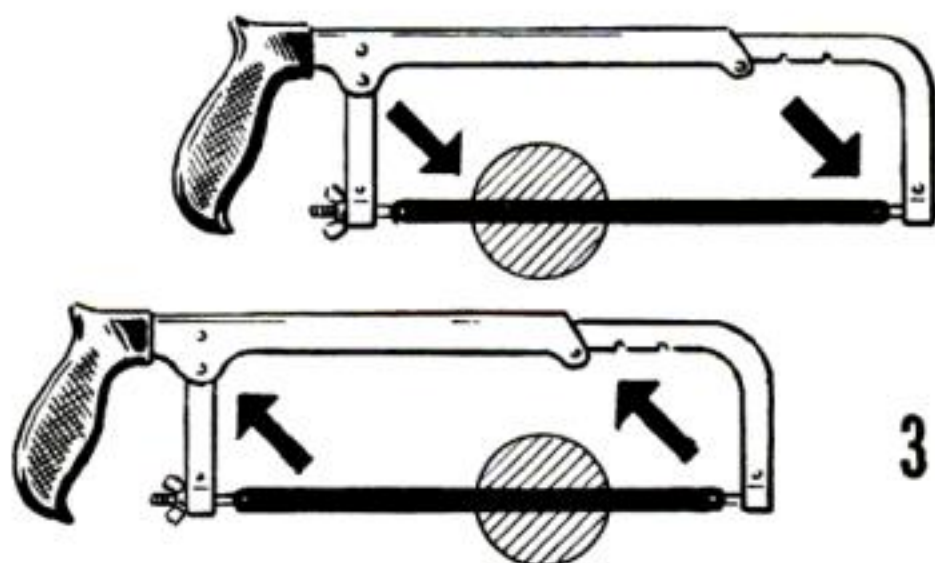
Finally, clamp any material that isn't square so you can saw with as many teeth as possible in contact with the metal at a time. Sandwich sheet metal between blocks, round stock between pads. (Drawing 5 shows typical vise setups.)



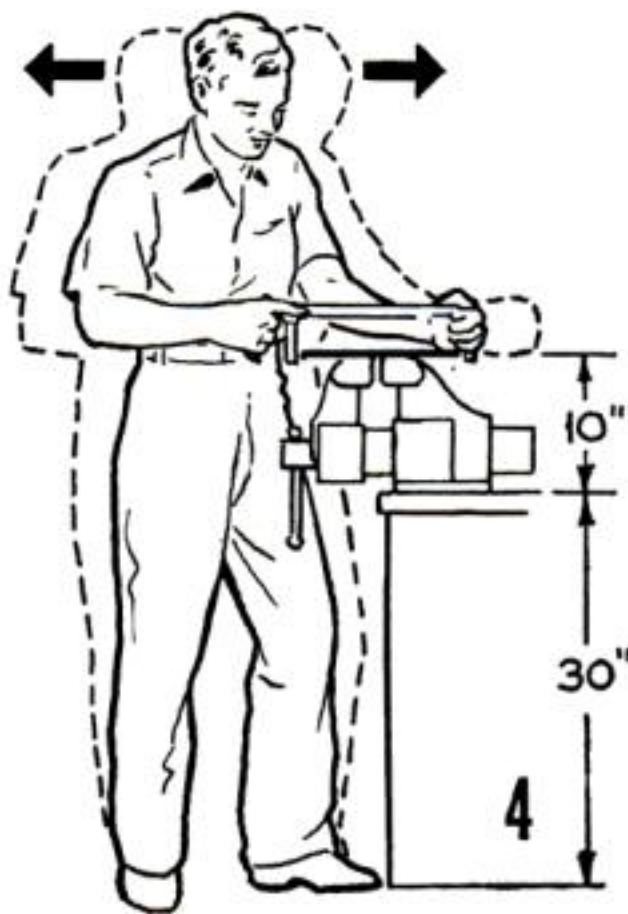
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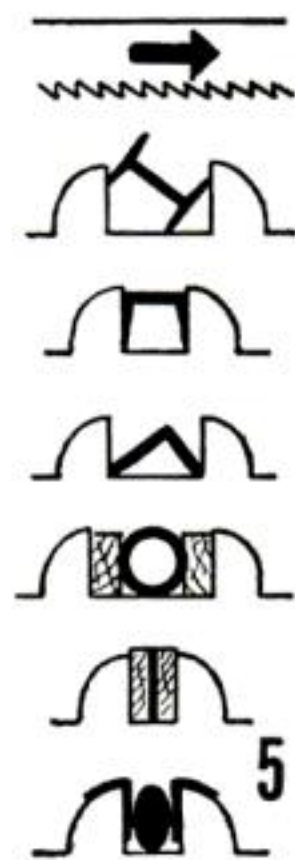
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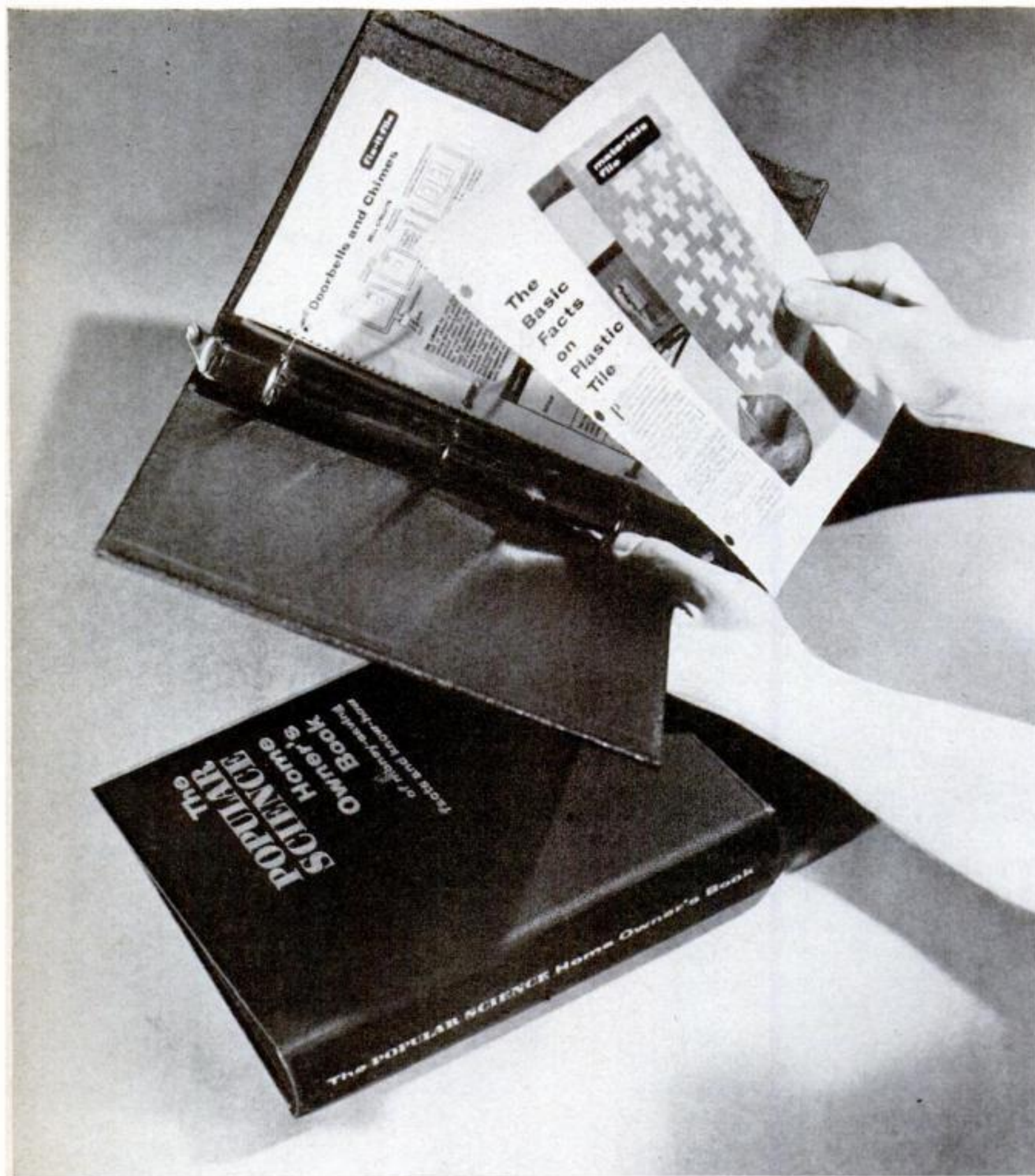
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5



Filing the Facts

NOW you can save, permanently, in easy-reference form, those valuable home-repair pages you find every month in **POPULAR SCIENCE**. A handsome, durable binder is now available to readers. It is designed particularly to hold the tear-and-file pages of the Home Owner's Section. The section, in turn, is designed for

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To get the binder above send \$2.50 and your name and address to: **Magazine Services, Inc., Dept. B-1058, 104 East 26th St., New York 10, N. Y.**

The Basic Facts on Ceramic Tile

CERAMIC tile is one of the most durable and easily cleaned coverings you can put on a wall or floor. Installations have been unearthed still intact after 7,000 years! Key facts:

- You can use ceramic tile anywhere in the house or outdoors.

- Floors and walls in your house might have to be strengthened or leveled to support tile—but this is less likely with new setting methods that cut the total weight in half.

- A tile contractor who uses either of two newer setting methods can save you money on labor.

- Many tile outlets sell to do-it-yourself-minded owners. They offer free advice and lend or rent tools.

- Tiles fall generally into two main categories: glazed and unglazed. Glazed tiles are moisture-resistant but tend to scratch. Use them on walls, particularly in bath and kitchen. Unglazed tiles can be



Ceramic Tile

WHICH KIND TO GET depends on where you plan to use it. Here are the various types available—their surface finish, range of colors, shapes, sizes, thickness and weight.

Glazed ceramic tile — a tile with glasslike finish fused to a fired-clay body

TYPE	RECOMMENDED FOR USE ON	COMMON SHAPES AND SIZES	THICKNESS	AVERAGE WEIGHT PER SQ. FT. (lb.)	NUMBER OF COLORS AVAILABLE
Glazed interior	Walls in bathrooms, kitchens, showers; also counters and fireplaces. Not generally recommended for floors because of possible scratching	Triangles, hexagons, squares, rectangles, from 2 1/8" (smallest dimension) to 12" (largest dimension)	3/8"	3	About 200
Extra-duty	Same as for glazed interior plus: Light-traffic floors, exterior decoration, vestibules and drainboards	Generally same as glazed interior	3/8" x 5/8"	3	Usually white; available only on special order
Ceramic mosaic	Any wall or counter surface, especially for highly decorative effects. Also for light-traffic floors	Triangles, hexagons, squares, rectangles, from 1/2" (smallest dimension) to 2 3/4" (largest dimension)	1/4"	5	Over 100

Unglazed ceramic tile — a hard, dense tile with unglazed surface; gets its color from the clay it's made of

TYPE	RECOMMENDED FOR USE ON	COMMON SHAPES AND SIZES	THICKNESS	AVERAGE WEIGHT PER SQ. FT. (lb.)	NUMBER OF COLORS AVAILABLE
Ceramic mosaic	Walls, floors, work surfaces, bathrooms, kitchens, porches, swimming pools, showers	Same as glazed ceramic mosaic	1/4"	5	Over 100
Paver	Floors anywhere, inside or out; also patios where a variety of colors is important	3" sq., 4" sq., 4 1/2" sq., 6" sq., 6" x 3"	3/8" x 5/8"	5-6	About 12
Quarry	Floors anywhere, inside or out; also patios where economy is important	2 3/4" sq., 4" sq., 6" sq., 8" sq., 9" sq., 2 3/4" x 6", 3 3/4" x 8", 6" x 9"	1/2" to 3/4"	6-8 1/2	About 6 shades of red and brown

used anywhere. And mild scratching won't be noticeable on their rougher surface.

Glazed interior tiles come in a variety of shapes and sizes. One helpful feature: The dimensions are modular; different shapes and sizes fit together so the edges line up.

Trim pieces and accessories are available to set off the tile. Among them are coves, caps, nosings, soap dishes, grab bars and glass holders.

A newly invented machine fuses individual glazed tiles into a rigid sheet. Panels 2 1/2'-by-6' are already being tried in some prefab shower stalls. Wider use of these laborsaving sheets can be expected soon.

Pavers and quarry tile are designed especially for heavy-duty floor use. They are unglazed and come as big as 9" square and 3/4" thick. Some have been "weather-tested" to make sure they can hold up on

roof decks and patios. One type has a nonskid surface.

Pavers are made from a mixture of several clays taken from different pits. Quarry tile, cheaper, is made with the clay from only one pit.

Mosaics are tiny tiles. You can cover a floor with the unglazed kind, or use glazed ones on a wall, countertop, or table. A new grout, for filling between tiles, resists staining by juices and cleansers. It's called, naturally, Resist-Stain.

Setting mosaics on any surface is no

longer a one-at-a-time affair. You can buy them attached to backing sheets already spaced for grouting and in a variety of patterns. If you want to create your own design, mosaics are also sold loose, of course. Squares and rectangles are the most common shapes used today.

Two recent developments make it easier for you to get good results in setting tile:

- Organic adhesives (often called tile mastics). These are used in over 60 percent of today's home installations.

- Thin-bed mortar. This is a special

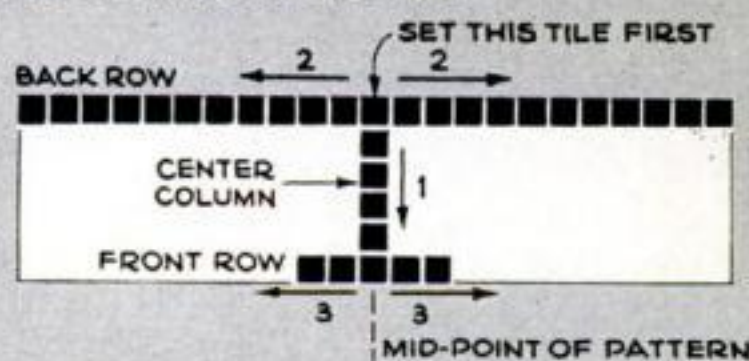
One easy job you can do with ceramic tile

TILED WINDOW SILL makes an easily cleaned, waterproof shelf for flowers or plants. All you need are \$5 worth of materials and a glass cutter and nippers. Lay out the tiles first without cementing, to find a simple pattern that minimizes cutting. Leave 1/16" between pieces for grout.

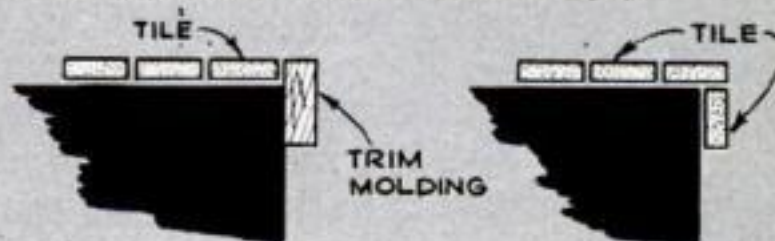


START by setting a middle column of tile. Then cement down back row, working outward from middle. Set front row and fill in remaining tiles, also from middle outward. Face sill's front edge

TILE-SETTING SEQUENCE



TWO WAYS TO FINISH FRONT EDGE



with vertical tile or wood molding and force grout into tile joints. Remove excess grout with damp cloth. Sketches show order in which tiles are set, and two types of edging.

How to prepare your walls for ceramic tile

TO SUPPORT TILE a wall must be strong, rigid and smooth. These recommendations by the Tile Council of America help you prepare various wall surfaces.

TYPE OF WALL TO BE COVERED	FOR TILE IN THIN-BED MORTAR	FOR TILE IN MASTIC
Bare studs (16" o.c. braced at mid-height)	Conventional plaster wall with metal lath recommended as base for tile. Cover studs with vapor-barrier paper first	Plasterboard commonly used as base for tile, but other strong, rigid materials, such as plywood and hardboard, also make good bases
Masonry (block or brick laid with Portland-cement mortar)	Damp-proof inside surface of exterior masonry wall and apply plaster wall over furring strips nailed 12" o.c.	Proceed as for mortar bed, but prime finished plaster wall before applying tile
Cement plaster, stucco or poured concrete	Wet surface and apply tile with mortar directly to it	Apply tile direct; wetting plaster not necessary
Plaster (unpainted)	Wet plaster and apply tile with mortar directly to it	Prime before applying tile directly to shower stalls or other moist areas. No priming needed in dry areas
Plaster (painted)	Scrape off loose paint and roughen any glossy surface. Apply tile directly	Scrape off loose paint, roughen glossy surface. If mastic solvent dissolves paint, prime wall with marine varnish or other waterproofing coat first
Plasterboard ($\frac{3}{8}$ " thick on studs 12" o.c.; $\frac{1}{2}$ " thick on studs 16" o.c.)	Apply tile directly	Apply tile directly to bare surface in dry areas, or to primed surface in moist areas
Plywood (exterior type recommended)	Prime with waterproofing compound on face and edges of plywood. Apply tile directly	Same procedure as for mortar
Hardboard (tempered type recommended)	Prime with waterproofing compound on face and edges of hardboard. Apply tile directly	Same procedure as for mortar
Cement-asbestos board	Apply tile directly to the rough side of the board	Same procedure as for mortar

Portland-cement mixture that can set tile in a bed as thin as $\frac{1}{16}$ ".

If a very uneven surface must be leveled, conventional mortar may still be needed. But wherever they can be used, the two new setting methods are much quicker than the traditional use of a mortar bed 1" thick or more. As important as the saving in labor, weight is cut in half. An 8'-by-10' floor, for example, would have to support only 500 instead of 1,000 pounds. Another way to save weight: Use small tile. Big tile pieces, thicker so they won't warp or crack, are heavier for the same area covered.

If details of the newer setting methods are not yet known in your area, the Tile Council of America (800 Second Ave., NYC 17) can send your contractor information on methods and materials. You might suggest that he write them.

The homeowner can cut the cost of an installation roughly in half by setting it himself. The tile alone costs from 40¢ to 85¢ a square foot.

A precaution if you're to be your own tile setter: Start with a small area and use a tile mastic that meets Commercial Standard 181-52 of the U. S. Department of Commerce.

Sagging Floors

fix-it file

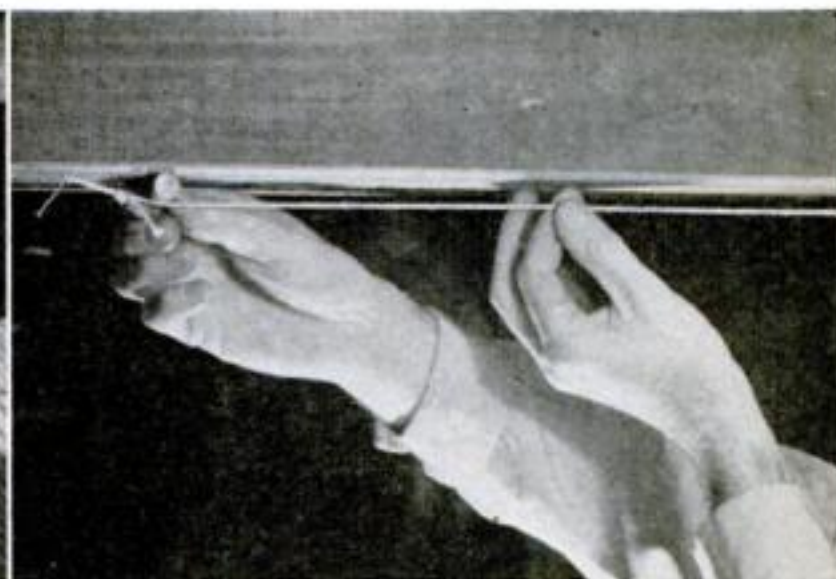
MAKE A QUICK CHECK of the floor with a straight board and a level, if you should notice that a child's ball always rolls toward the same spot in a room. The board will disclose the location of the hollows in the floor, and the level will tell you how serious the slope is.



How to measure sag

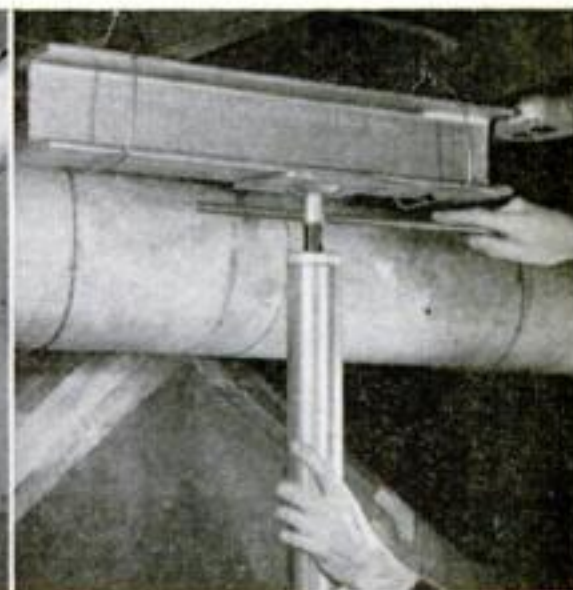
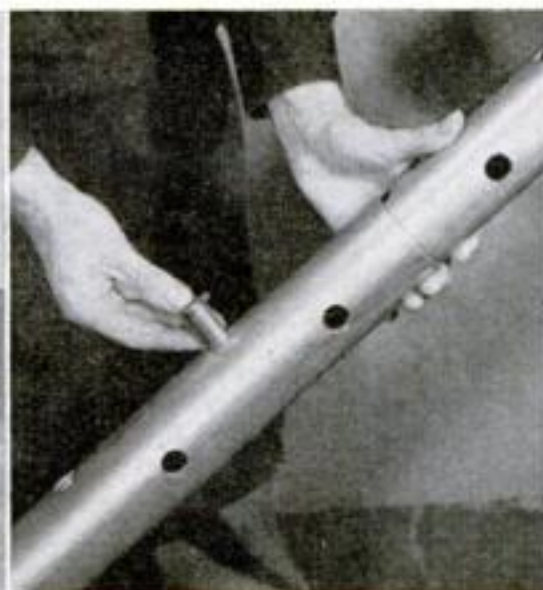


STRETCH A STRING from wall to wall and close to the floor. With the string pulled straight and taut, you can measure the amount of sag. Take measurements with the string across different parts of the room to find the deepest point of the sag.



IN THE BASEMENT, check sag by stretching a string from nails driven into the underside of the joists. Insert dowels for spacers at each end of the string to keep it away from the joist. Sag in a series of joists can be detected by running the line across them.

How to raise the floor



JACK UP THE SAG with a builder's or heavy automobile jack and a four-by-four post or length of heavy pipe. Raise the floor *slowly* over a period of weeks to avoid sudden strains and resulting damage to plaster, plumbing and the building structure. You

can buy telescoping posts (center) that adjust roughly to the desired height and lock together with a steel pin. Pressure is then applied by turning a screw-pad on top of post (right). A short length of I-beam should be used to distribute the pressure.

How to add permanent supports



A PERMANENT POST can be installed where load is concentrated, as beneath a piano, or to stiffen a wide span. If floor flexes when Junior jumps on it, chances are you *need* a post to add rigidity. Post above is for light support. For a main post, dig a square hole

2' wider than the base of the post and a foot deep. Tamp concrete into hole (center), adding about 3" between tampings. Keep concrete damp for several days to cure it before setting up the post. Plumb the post (right) before you anchor it in position.

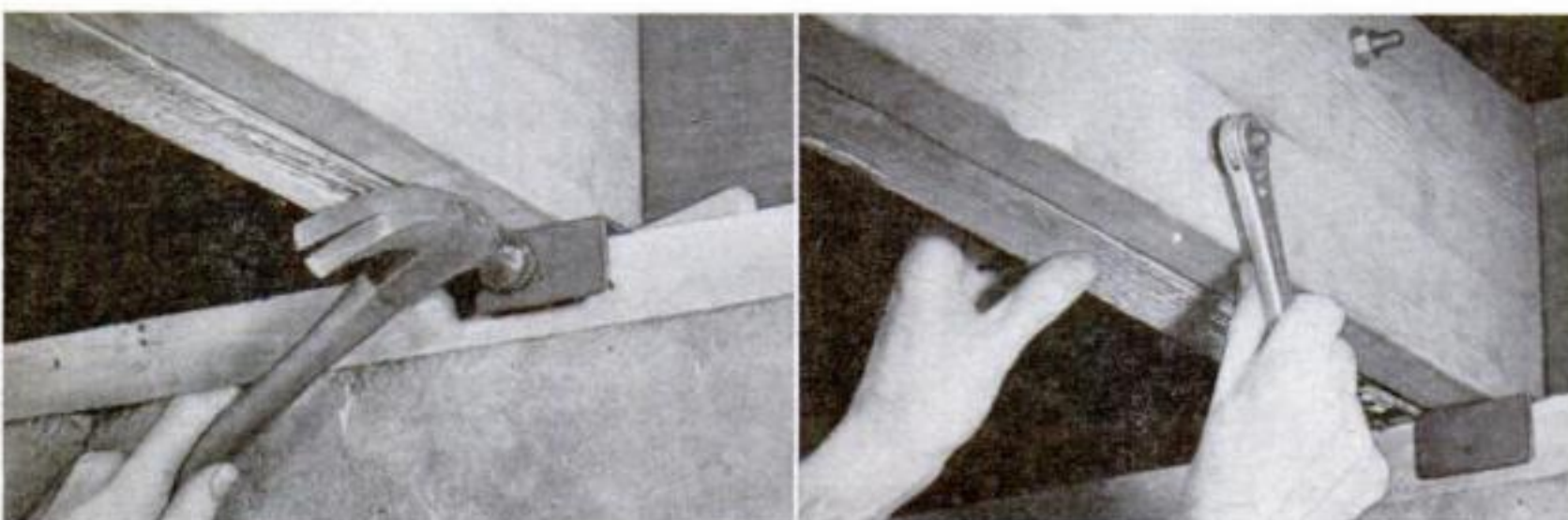
Bracing the floor



BRIDGING—strips of one-by-three pine—distributes floor loads. If yours are missing, loose, or are spaced more than 8' apart, add new ones while supporting the sag with a temporary jack-post. Tie joists with angle irons where they butt against headers (cen-

ter). If a joist has been cut away for ducts or pipes, hang the cut end on adjacent joists with long bolts and a strap-iron bracket (right). Add extra bridging or two-by-eight spacers in this area to keep the rods from pulling the adjacent joists inward.

How to add a joist



CUT A NEW JOIST and place it beside a cracked or badly warped joist to reinforce it. Drive wedges under new joist to force it snugly upward against floorboards, then force in a steel plate or angle of suitable thickness for a firm bearing area.

BOLT OLD JOIST TO NEW ONE, jacking it up temporarily if necessary. If old joist is cracked, drill holes for $\frac{3}{8}$ " or $\frac{1}{2}$ " bolts on each side of crack to splice across it. Tighten the nuts on large washers to pull the joists together, then remove the jack.



Whether you're buying an old home or planning to build, you should know—

What Cracks Can Tell About a House

By David X. Manners

CRACKS are clues. Whether they're in plaster, floor slab, foundation walls, or chimney, they have a story to tell. In an old house, they can tip you off to structural weaknesses you might otherwise overlook. And if you know their cause, you can build to avoid them.

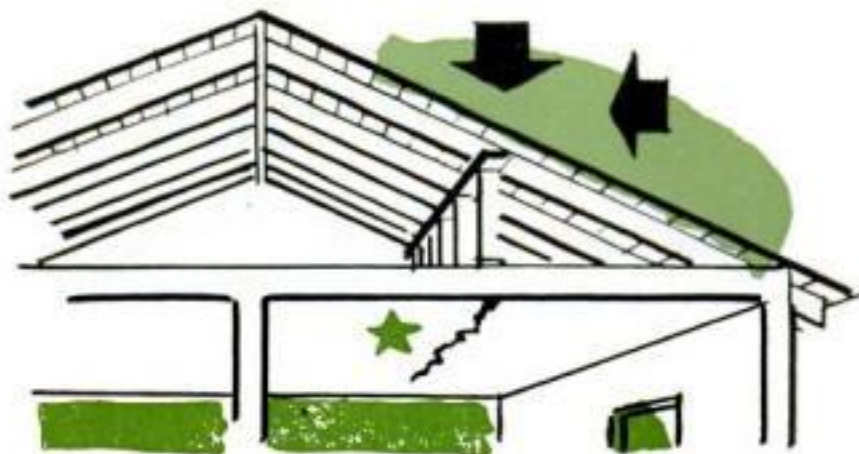
Almost any new house will develop some cracks in the plaster as the house settles, or "finds itself." Once patched, they should not reappear. If they do,

.....

The honeymoon with your home is over. Troubles pop up like mushrooms after rain: settling... shrinking... swelling... Take heart. Read "How to Break in Your New House"—in November PS.

Learn the lessons of house cracks. Here's a quick guide

Cracks are usually symptoms of a house that's ailing—but where, and how seriously? In many cases the malady is minor—come up with the right diagnosis and you may be able to apply a cure in time. Knowing why houses crack—and where and when—can help you shop for an older one, or add years to the life of the home you're building.



If a roof can't take weight of snow and pressure of wind, look out for ceiling cracks.

basic construction flaws may be present. Let's take a look from the ground up.

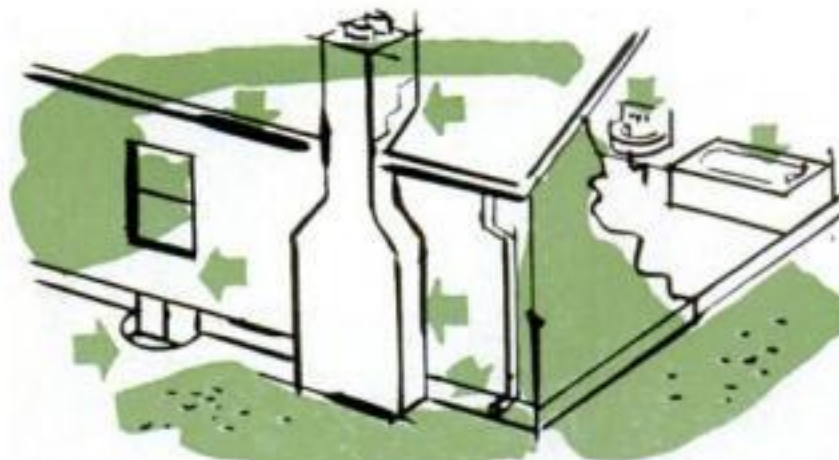
Foundation shift. A good foundation stays put, or settles evenly. If it becomes lopsided, the house twists. Cracked plaster and masonry may result. Early warning of an off-keel foundation is likely to show up as cracks in plaster (the weakest material in a house) extending diagonally across a wall from the corners of doors and windows (weak points in a wall).

A house built on newly filled land is apt to become a victim of unequal settling. Usually it isn't serious, and with proper care in making the fill, a bulldozer-made site will stand up nicely—especially if the foundation is put in right. If it isn't, even good, solid ground won't solve the problem.

Inadequate footings. Footings are the extended base of a foundation wall that spread the load over a wider area. Normally, they should be twice as wide as the foundation wall is thick, and at least as deep. On filled or otherwise unstable ground, they should be wider. The main thing is to get uniform bearing. If the lot is half bedrock and half soil, the extra-wide footings are needed on the soil side. In all cases it is important that the wall be centered on the footing.



Inadequate footings can cause a house to settle unevenly. Cracks are inevitable.



Water damage is a main cause of cracks. Here's where to look for hidden leak points.

Footings too shallow. You'll meet this notorious crack-maker most often in slab and basementless houses. If the footings are not below the frost line, soil moisture freezing underneath will cause them to heave and twist the house. Repeated upward thrusts can have the effect of built-in miniature earthquakes.

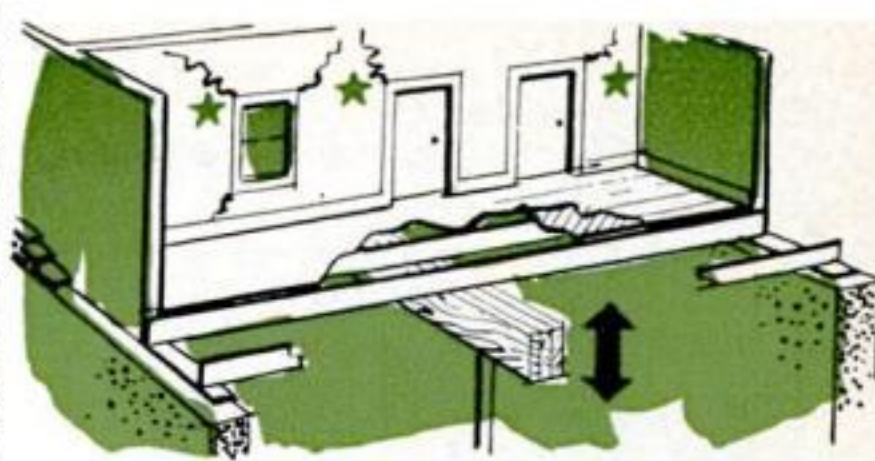
It works in reverse, too. When the footings are too shallow, the soil under them may dry out during dry hot spells. What happens? As the soil loses moisture, it shrinks more on the outside of the house than on the sheltered inside. The footings settle toward the outside, tilting the walls they support. Where the walls are held rigidly by floor framing, horizontal cracks appear.

Sometimes a new wing added to a home will show up cracks even though there are none in the older structure. There's a reason. The area around a house is often backfill, bringing us back to the problem of uneven settling. You can avoid this headache by planning for an addition when you are building. When the original footings are put in, add 18" extensions of 1/2" steel reinforcing rods. Later, these will tie in the footings you add for the wing.

Now let's go into the basement. Do



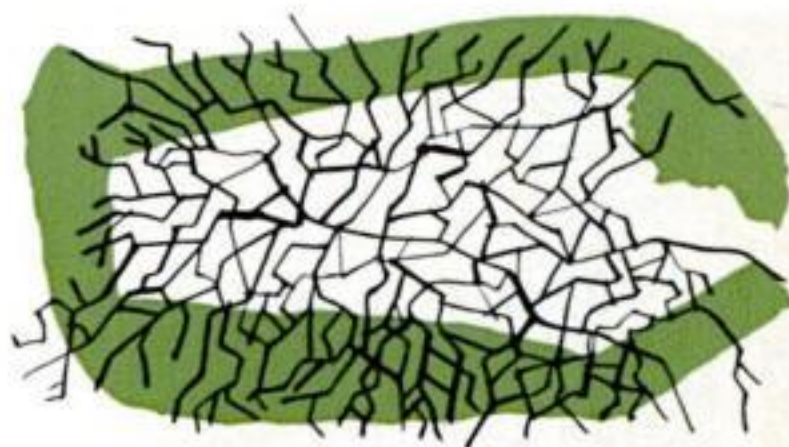
Weak foundations may bulge and crack as weight and pressure of soil take effect.



Shrunk wood beam in basement invites cracks. Use steel beams or masonry walls.



Map cracks: Poorly bonded plaster expands and contracts with temperature changes.



Crazing cracks: Plaster coat was too rich, or dried too fast, or was badly troweled.

floor cracks radiate from the middle-of-the-house posts or piers? That probably is a sign that the supports are resting on the floor slab instead of on separate sturdy footings. So, when you build, remember that the minimum satisfactory footing for a major supporting column is 24" square and 12" deep.

Foundation walls. If they're not strong enough, you'll know it by horizontal cracking at the grade line or halfway up. Weight of the soil alone can cause cracks in a wall that's too thin. If that doesn't do it, the expansion pressure of frozen wet soil will. This is a good reason, incidentally, for making sure that water will always drain *away* from the foundation of the house.

How hefty must a foundation wall be? At least as thick as the house wall it supports. Concrete should be at least 10" to 12" thick, though if reinforced it can be 8" without danger of buckling. No unreinforced wall or pier should ever be higher than 10 times its thickness.

You can't trim these figures for a small house. Walls supporting a very light load are less stable than walls working closer to capacity.

A wall can have bulk and still lack muscle. Concrete and mortar must be

properly mixed and used. Never allow it to freeze before it sets. You may not always be able to check on how a builder is mixing his concrete, but if you know the facts, you lessen the chances that he'll try short cuts. The standard formula for footings is one part cement, three of sand, and five of aggregate; for walls, the formula is 1: 2: 4.

Cracks in block foundations often indicate that backfilling was done before the first-floor framing was in place to brace them. Vertical cracks in block walls, or in stucco applied over them, may mean that the blocks laid were too new or wet. When they shrink later, the cracks are formed.

Check the framework. Was green lumber used? Are the joints and rafters as beefy as they should be? Is it all well braced?

Cracks will tell you.

All house frames move. Materials expand and contract with temperature and humidity changes. Making a house rigid to start with keeps these movements to a minimum.

Cracks in the ceiling parallel to the direction of floor joists, and in walls at a 45-degree angle, indicate a sagging floor. The floor joists may be too light, too far

apart, or not reinforced by cross bridging.

Usual floor-joist size is two-by-ten, with two-by-eight the minimum. Fir two-by-tens on 16" centers will span up to 17', but two-by-eights, only 13½'. Local codes and building inspectors probably will safeguard you on this. Joists that were adequate originally, however, may be weakened by the installation of ducts and plumbing. Then cracks may attack you if you don't watch out.

A partition placed over one joist, or on a subfloor over no joist, will lead to a sagging floor and cracks at the joint where the partition wall intersects other walls.

Subflooring laid diagonally, or made of plywood, helps brace the house. It's not too important on the first floor, where the foundation helps hold the line, but on the second floor it's essential if you want to discourage cracking.

For rigid walls, the studs must be doubled at all openings, tripled at corners. If wall sheathing is other than plywood or diagonal boards, braces must be cut into the studs at corners. If they aren't, count on the house to echo to the sound of cracking plaster.

Ceiling cracks, seen along the bottom of attic knee walls point to a roof that's not rigid enough. If knee walls help to support the roof, the weight of snow and the pressure of wind will bear directly on the joists under the knee walls. Look for the plaster to crack.

How nails help. A typical 1,200-square-foot house and attached garage takes about 650 pounds of nails to hold it together. But *good* nailing does more than hold a house together. It helps to distribute strain over a large area, so that it is less likely to show up as cracks. If you're building, here's good advice: Don't skimp on nails.

On the other hand, nailing can be overdone. Too many nails, or nails that are too large, will split or weaken boards. If the lumber is green or wet, the best nailing can go to waste. When the lumber dries out, it will shrink from the nail shanks, and they lose their grip.

Shrinking can be minimized. Lumber shrinks and expands across the grain, but hardly at all lengthwise. A poor technique is the use of a heavy horizontal wood beam at the middle of a house to support the inner ends of floor joists. Seasonal changes in humidity, especially if the

beam is near the furnace, may cause it to ride the floor up and down.

This crack-maker can be avoided by substituting a steel beam or a masonry wall. If a wood beam is used, it should be flush with the top of the joists and the joists supported by steel stirrups, or on two-by-three ledger strips spiked to the beam.

Where walls meet ceiling. Here cracks are usually the work of excessive expansion and contraction of the plate on top of the wall studding. Upstairs, the cause may be a poorly ventilated attic, building up moisture in winter, drying out in summer. In other parts of the house, framing may be shrinking bone-dry for the lack of a good humidifier on the furnace.

Different materials, because they do not expand and contract at the same rate, very often cause cracks when used together. Where wood is encased in masonry, be prepared for the masonry to give. Windows and doors in a brick-veneer house frequently develop cracks running around the frames. In dry weather the wood frame shrinks away from the masonry shell, leaving a gap. In wet weather the gap will close if seasoned lumber was used—but the cracks that have formed meanwhile will remain.

Cracks at doors and windows aren't always the result of foundation settling. Sometimes the cause is the movement of cross-grain lumber spanning the openings. It's a case of where more isn't better. These headers should be kept to minimum size. For spans up to 3', two-by-fours are okay. For larger spans, two-by-four trusses do a better job than heftier headers. If cross-grain wood is used to frame plastered arches, it will almost surely shrink and crack the plaster. Metal forms are the antidote for this type of crack-up.

Hidden water leaks often come out in the open as plaster cracks. Since plaster expands when wet, it first buckles, then cracks, and finally falls off the walls or ceilings. Check for defective plumbing and flashing, and roof leaks.

Blasting takes the blame for a lot of cracks for which it is not responsible. Government statistics put vibration way down in the list of crack-causers.

And as for earthquakes—well, if you get off with only some cracks in the walls, you're lucky. END

9 Timely Tips on Battery Care

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AS DAYS GROW SHORTER, don't keep the main headlights on during a long idle stop. Amps disappear fast in chilly weather and are difficult to replace.



USE THE STARTER IN SHORT TAKES to allow the battery to recover. A long, steady drain could kill it.



FAST-IDLE THE ENGINE with the car in neutral to put some amps back into the battery while waiting for traffic to clear. Or install an ammeter and instruct the wife to "step on the gas" till it shows Charge while waiting for your train at the station.

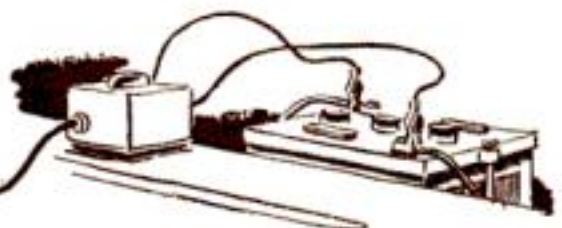


BEAT A SEVERE COLD SPELL by wrapping a sick-room heating pad around the battery through the night. A warm battery will have a harder punch in the morning.



IN COLD WEATHER, add water to your battery in the morning, before you drive the car. Water put in at night won't mix with the electrolyte, and may freeze, resulting in damage to the battery case and cells.

HOOK UP AN INEXPENSIVE TRICKLE CHARGER to the battery during the night to boost it to full capacity. A rectifier-type (DC) toy-train transformer can be used. Set the charging voltage by dividing the "miles-per-hour" scale in thirds—the first third puts out six volts, second third, 12 volts. Don't use the 18-volt setting



KEEP THE TOP OF THE BATTERY CASE CLEAN AND DRY. Check it after driving through a heavy rain. Moisture lets current escape between the terminals, or from the hot terminal to the cradle.



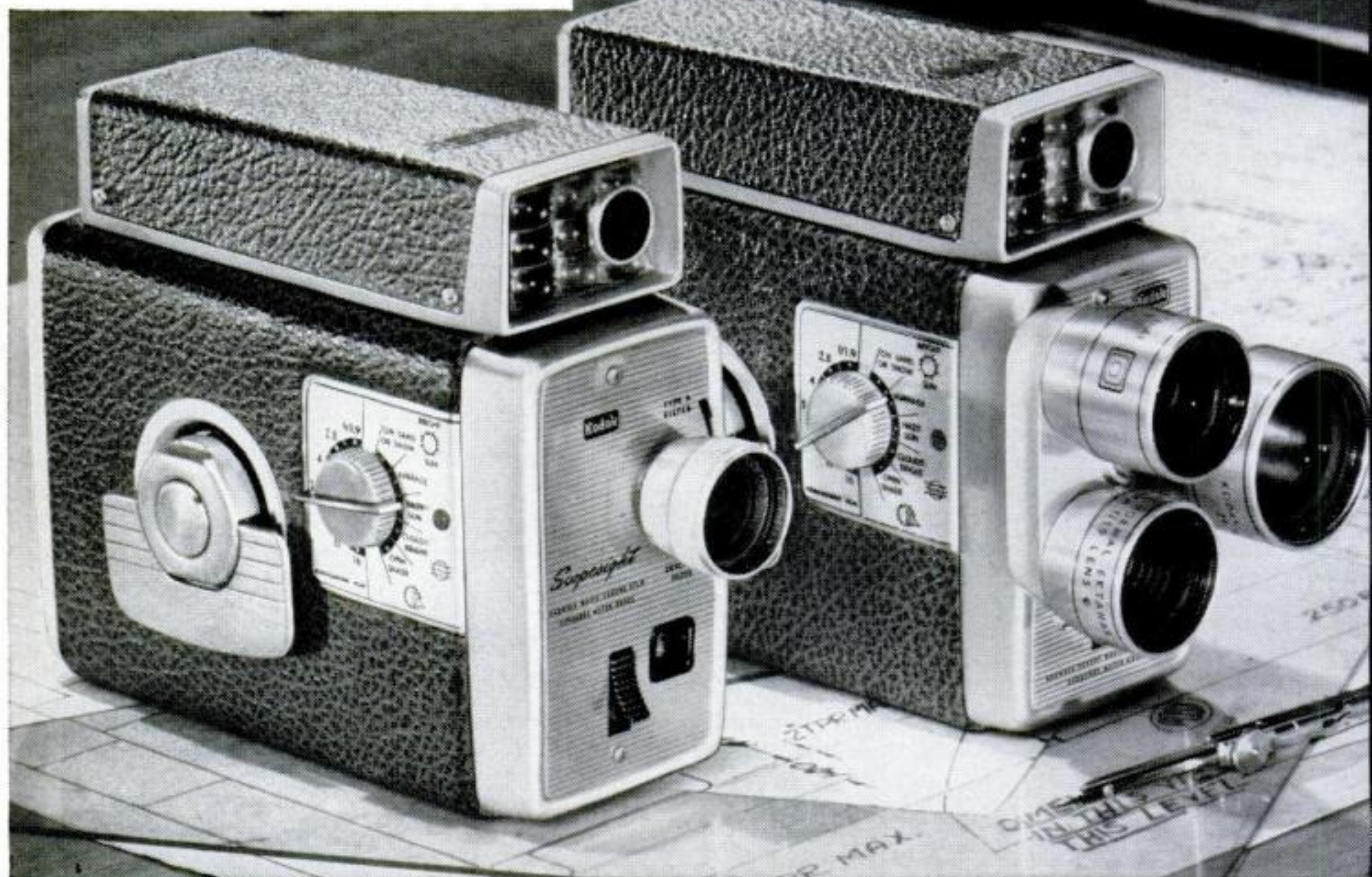
TO GET ALL THE CURRENT your battery can deliver, remove cable terminals twice a year and scrape them and the battery posts clean. Lightly coat contact surfaces with petroleum jelly and tighten the terminals securely.



CHECK THE WING NUTS ON THE BATTERY HOLD-DOWN occasionally. They should be snug enough to hold the battery secure against vibration that might injure cells but not so tight as to cause the hold-down frame to dig into or distort the case.



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Automatically shows you when exposure is right . . . lets you make beautiful color movies, reel after reel

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Handsome and compact, these new Brownie cameras have true telescopic

viewfinders with eyepiece adjustable to user's eye . . . built-in Skylight and Type A filters . . . easier loading mechanism . . . automatic footage indicator. 3-lens model has new, easy-swing turret. Here are movie cameras unmatched for value!

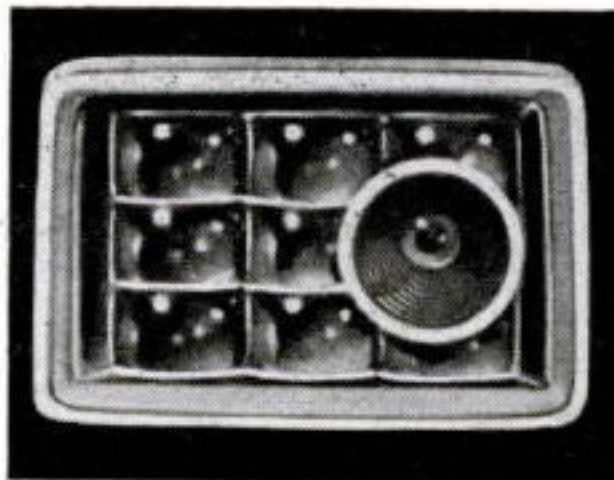
Ask your photo dealer to demonstrate the new "Exposure-Meter" Brownie Movie Cameras with fast $f/1.9$ lens. Many dealers offer easy terms.

Brownie Movie Camera, Scopesight $f/1.9$ (Exposure-Meter Model), \$79.50. Turret Model, \$99.50.

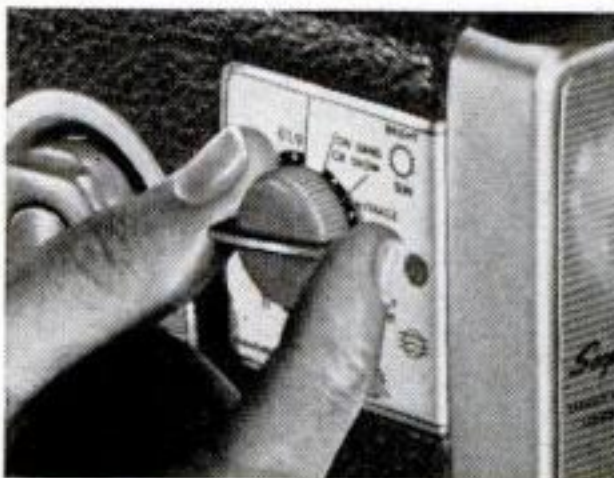
(Prices are list, include Federal Tax, and are subject to change without notice)

EASTMAN KODAK COMPANY,

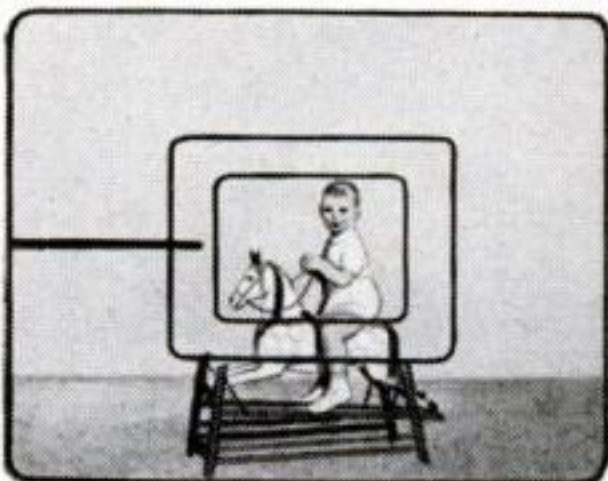
Coupled photoelectric exposure meter measures light as you shoot. The meter pointer is visible in the viewfinder.



Exposure-control knob lets you adjust meter pointer while you shoot. No need to take camera from your eye.



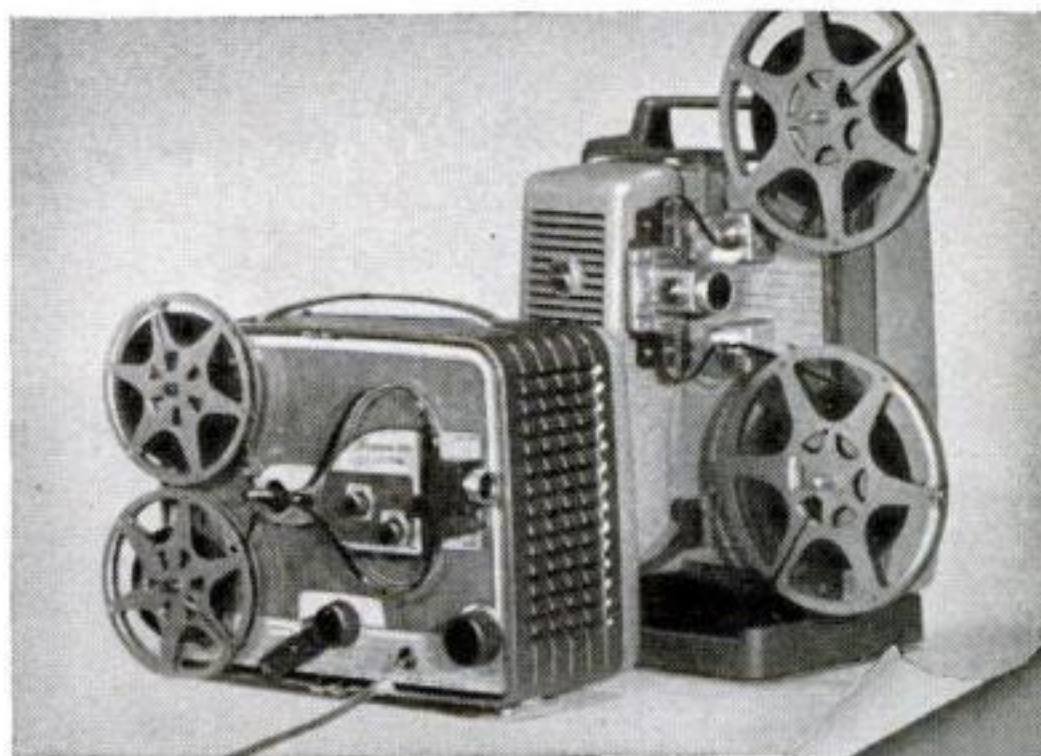
Perfect exposure before your eyes—simply by centering pointer in viewfinder. Multi-frames show fields covered in standard, wide-angle, and telephoto views.



built-in exposure meter

Projector mates for new Brownie Movie Cameras

Brownie 500 Movie Projector for sharp, brilliant, big-screen movies, \$79.50. New Kodak Showtime 8 Movie Projector (right) has 750w lamp for *extra-brilliant* screen image, shows movies 5 feet wide at 20-foot distance. Includes new built-in Presstape Splicer for clean, dry, "weld-strong" splicing without cement. \$174.50



See Kodak's "*The Ed Sullivan Show*" (CBS-TV) and "*The Adventures of Ozzie and Harriet*" (ABC-TV)

Rochester 4, N.Y.

Kodak
TRADEMARK

OCTOBER 1958 197



HO4S-3G Sikorsky, used by U. S. Coast Guard for air-sea rescue, shown here over Long Island Sound.

Q. Why do more aircraft the world over use Champions than any other spark plugs?

A. In the air dependable power is vital! To get that same dependable power in your car, put in new Champions every 10,000 miles. You'll save gasoline, too!



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CHAMPION



Are You Wasting Money on Premium Gas?

By Hubert Lockett

WILL your car start easier, give more power, deliver more miles per gallon if you feed it premium or superpremium gas?

Maybe. But only maybe.

Before you spend extra dollars on the deluxe fuels, it will pay you to find out the facts. Much publicity about these fuels has been confusing and, perhaps, misleading. Here are straight facts, ob-

tained in Detroit from top "engine engineers"—the men who designed the power plant under your hood. They say:

- The significant difference between gasoline grades is in octane rating.

- The octane rating tells you *nothing* about a fuel except its antiknock quality.

- Buying more octanes than you need is wasteful. They will *not* necessarily 1) give more power, 2) provide greater mileage, 3) make your car easier to start, or 4) supply mysterious benefits that will

Inside your engine's combustion chamber

1. *Normal combustion.* Fuel-air mixture is ignited only by timed spark. Flame front moves uniformly across chamber at normal velocity. 2. *Spark knock.* Timed spark starts combustion. Unburned gases get hot enough to start another fire in a remote part of chamber. Violent, uncontrolled burning of remaining fuel results in knock that is regular, recurrent and controllable by spark advance. 3. *Surface ignition.* Hot spots in the chamber and glowing deposit particles initiate flame either before or after timed spark, causing a knock that is irregular and not controlled by spark advance.



increase the life of your car's engine.

- It is simple to determine which gas grade comes nearest to meeting your engine's octane needs, and then to tune the engine to match this grade precisely.

Octane rating is often misunderstood. It's a technical term with a number, and it *seems* to be a yardstick that measures general quality. The numbers sound like grades on an examination paper—and everybody knows that 95 is better than 90, and 100 is better than either. But when it comes to octanes, that view is deceptive.

What is true is that higher-octane fuels are more expensive to produce. (And in a very special way they are better: They allow the designer to build higher compression ratios into an engine. And high compression pays off—you get more work out of a gallon of gas.)

But for the car owner, suiting an engine's needs is the real criterion as to whether higher-octane gas is better. Think of the octane scale as a tape measure used to fit a suit of clothes. If the octane rating of a fuel meets an engine's requirements, there's nothing gained by paying for more—it would be like a size-36 man buying a size-40 suit because the higher number sounds more impressive.

And mark this: The automobile engineers I talked to say that in most instances they find *no consistent differences, other than antiknock behavior,*

among typical regular, premium and superpremium fuels.

Which grade do you need? You can find out the same way that design engineers do: Listen. There's nothing esoteric about it; you don't need technically sophisticated ears.

Long ago automotive engineers learned that the knock, thud or ping you hear from an engine under load is a sure indication that the fuel is not burning properly. The noise, which comes when the compressed fuel-air mixture suddenly explodes, means trouble—loss of power, overstressing of engine parts, the possibility of damage. The octane scale is merely a numerical description of a fuel's ability to resist this uncontrolled explosion. To measure an engine's octane requirement, the lab men simply run it under load on a variety of special reference fuels and listen for knock.

Since you are not going to run your car on laboratory reference fuels, there's no need to bother with the exact numerical octane requirement of your engine. You need only feed it the lowest-priced grade of fuel on which it will not knock.

The jump in octane number between grades is fairly large, often seven or eight points. So if your engine knocks slightly on regular, it is not easy to upgrade its fuel just a point or two to kill the knock. (There's one exception here: The Sun Oil Company has lately been marketing, in

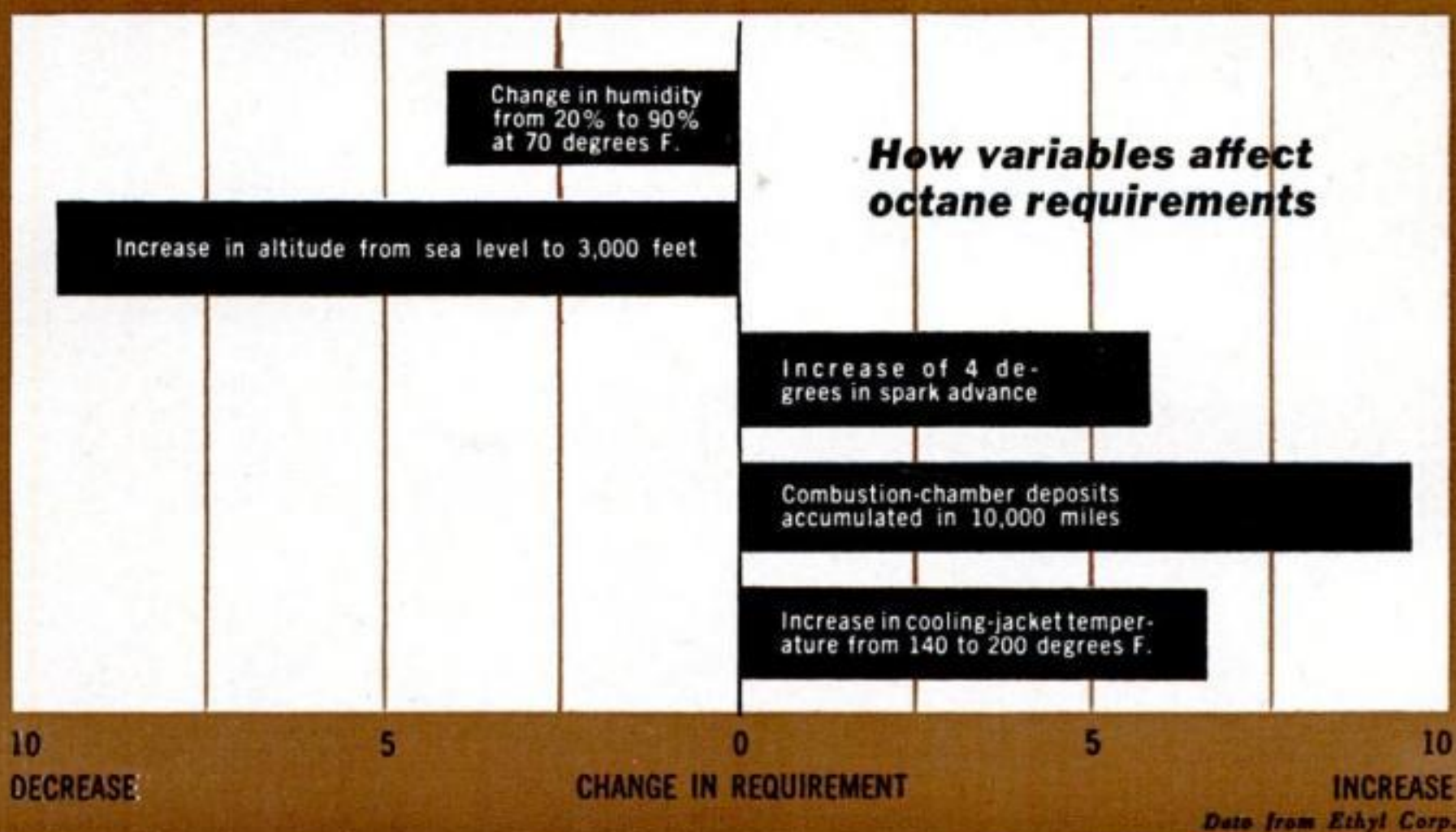


some areas, a choice of six fuel blends, spaced in smaller steps than the conventional two or three grades.) But it's easy to modify an engine's octane appetite so that an *approximately* correct grade of fuel fits it exactly.

An engine is designed to work efficiently on a particular grade of gas, usually specified in the owner's manual. This would seem to end any doubt; but there

are four variables that a blanket recommendation obviously cannot take into account:

- Two seemingly identical cars may have different octane requirements. Reason: a "stack-up" (accumulation) of manufacturing tolerances.
- Octane ratings of gasoline grades may vary by brand, locality, season.
- Octane ratings of all grades have



been going up. Much regular gas sold today is actually higher in octane number than premium gas was in 1954. (This means that a four-year-old car that needed premium when it was new may be perfectly satisfied by today's regular.)

- An engine's octane requirement is not constant. Combustion products build up inside at varying rates, depending on how you drive, the kind of oil you use, even where you live. This build-up adds to the octane requirement. But it does not increase indefinitely; the deposits (and the increase in octane requirement) usually stabilize between 5,000 and 15,000 miles.

Tailoring your engine. You can decrease octane requirement by retarding the ignition timing slightly. Conversely, if you have octanes to spare, you can get a very slight gain in power and fuel mileage by advancing the spark.

If you're a Saturday-morning mechanic, this is a quick and simple job; if not, a garageman can do it for you in minutes. In either case, there's one important caution: Make sure that the setting does not exceed the maximum permissible range specified by the manufacturer.

One Big Three engineer advises staying within four degrees, plus or minus, of specified timing. He tells the cautionary tale of a friend who had a speaking acquaintance with engines, acquired on the old flathead V-8s. This friend, after buying a hot new OHV car, tanked up with superpremium and went out to tune it up the old way. He made several trial runs, advancing the spark each time. No knock. Pressing his luck, he went well beyond the maximum recommended advance. Since the car still didn't seem to knock, he tried a high-speed run—which promptly burned a hole in a piston. What happened was that the knock, when it finally came, was cumulative, self-feeding, and disastrous.

Can you upgrade an engine? Detroit engineers are unshakable on one point, even if the gasoline companies seem to be saying otherwise: It seldom, if ever, pays to retime an engine to use a higher grade of fuel than it was designed for.

One technical man who has run extensive tests reports that with an engine designed for regular but retimed to burn premium, the biggest gain he could detect was an increase of a half-mile per gallon.

This was the *best* showing. In other cases, regular gas actually gave better mileage. Acceleration was only trivially improved.

Spending extra money for gasoline in an effort to treat real or imagined ills in an engine is a poor idea, the experts assert, unless the specific complaint is knock. Even here, if an engine has been running right on a particular grade of gas and then begins to knock, treating the knock by stepping up a grade may be treating symptoms rather than causes. Anything that causes excessive engine temperatures can cause a knock, including a loose fan belt, stuck thermostat, defective radiator, faulty water pump.

If hard starting is your problem, it's smarter, I was told, to treat it by cleaning or replacing the plugs and distributor points, and by checking the automatic choke, than it is to buy deluxe gasoline. There is no significant difference in "startability" among fuel grades. Tests show minor variations, but they do not consistently favor one grade over another.

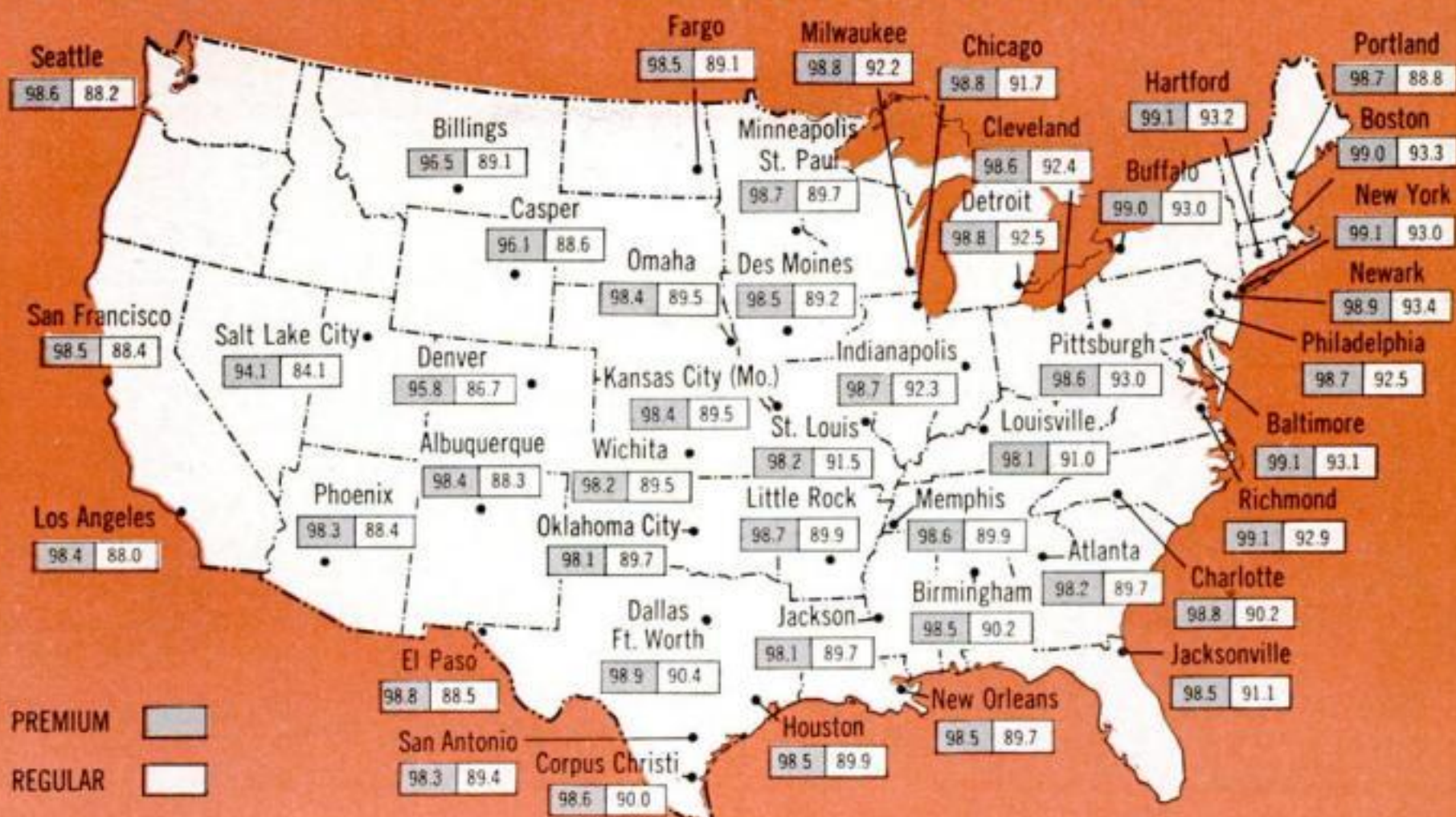
Nor can you buy a "more powerful" gasoline. All commercial gasolines have essentially the same energy potential. The power you receive depends on the design and condition of your engine, provided it burns the gasoline you feed it without knocking.

If you have a new car, it is still not necessary to assume you must use premium or superpremium gas. Ford, Chevrolet, Plymouth, Studebaker and Rambler presently design their standard engines to run on regular fuel, as a matter of policy. But their more powerful optional engines usually are designed for premium, as are the engines of most of the other makers. The owner's manual specifies the right fuel grade.

Modern motor fuel is the complex result of half a dozen different petrochemical processes. Some yield more octanes; some are cleaner-burning; others have maximum energy per gallon. A good fuel has all these characteristics in proper proportion—you can't make a high-grade fuel simply by pouring a hot-foot additive into any old base stock.

But additives *are* important in the final product. Tetraethyl lead, referred to in labs as TEL, has long been used to increase octanes. This doesn't mean you can't make high-octane fuel without TEL; it means there is a point reached in

Here are recent octane numbers of U. S. gasolines



AVERAGE OCTANE NUMBERS of gasoline sold in various cities is shown by this recent sur-

vey made by Ethyl Corp. Note that numbers are usually lower at higher altitudes.

blending high-grade fuels beyond which most refiners find it more efficient to gain octane numbers by adding TEL.

Actual amounts of TEL vary for even the same brand and grade of gas. This is because refiners use it as a sort of vernier adjustment to maintain a uniform octane rating. Contrary to common opinion, the grade of gasoline is no clue to the amount of TEL present. Sometimes regular will contain more than premium in the same brand.

Phosphorus compounds make up another family of additives, used to correct one drawback to leaded fuels. Under certain driving conditions, a lead deposit may form on spark-plug insulators, short-circuiting the spark and causing irregular misfiring. These additives cause a chemical change in such deposits that increases their electrical resistance, eliminating the short.

Some petroleum-company research indicates that the phosphorus additives may have a second use, in controlling "surface ignition." (This is premature ignition from glowing particles of the combustion-chamber deposits.) Auto engineers aren't in complete agreement, however, that

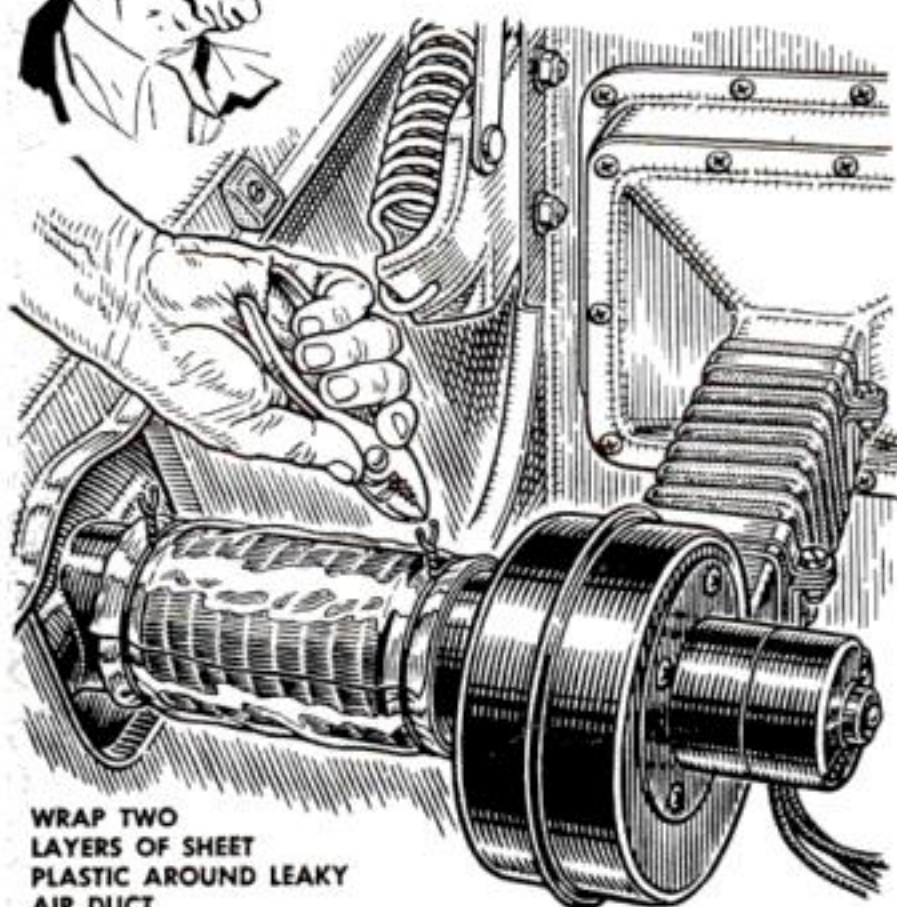
this surface-ignition effect is significant.

Vapor lock, a continuing problem, is being worked over intensively now, by both engine engineers and refineries. The difficulties arise from conflicting needs. The engine designer has to put bigger engines in accessory-crowded compartments and under lower hoods. This raises under-hood temperatures—which invites vapor-lock trouble. The fuel engineer has his problems: notably, to increase the supply of high-octane fuels without running the cost up. Most refineries have a plentiful supply of “light ends”—stocks that, while high in octanes, may also be quite volatile and therefore vapor-lock-prone.

By steadily boosting octane ratings, the petroleum industry has permitted engine designers to raise compression ratios almost every year. And it is this compression increase that has been important in higher engine efficiency. But you'll save money if you remember two things: 1) the superpremium pumps dispense a fuel designed for a relatively small percentage of the cars on the road, and 2) this fuel won't and can't make a bomb out of the four-year-old family sedan. **END**



Hints from the Model Garage



WRAP TWO LAYERS OF SHEET PLASTIC AROUND LEAKY AIR DUCT

Seal out engine fumes—if they're finding their way into your car through pin-holes in the heater duct—with a simple but effective boot of plastic material. Wrap the material twice around the duct and close the ends with wire, twisted tight.



STAINLESS-STEEL SCOURING PAD WILL LEAVE NO RUST STAINS

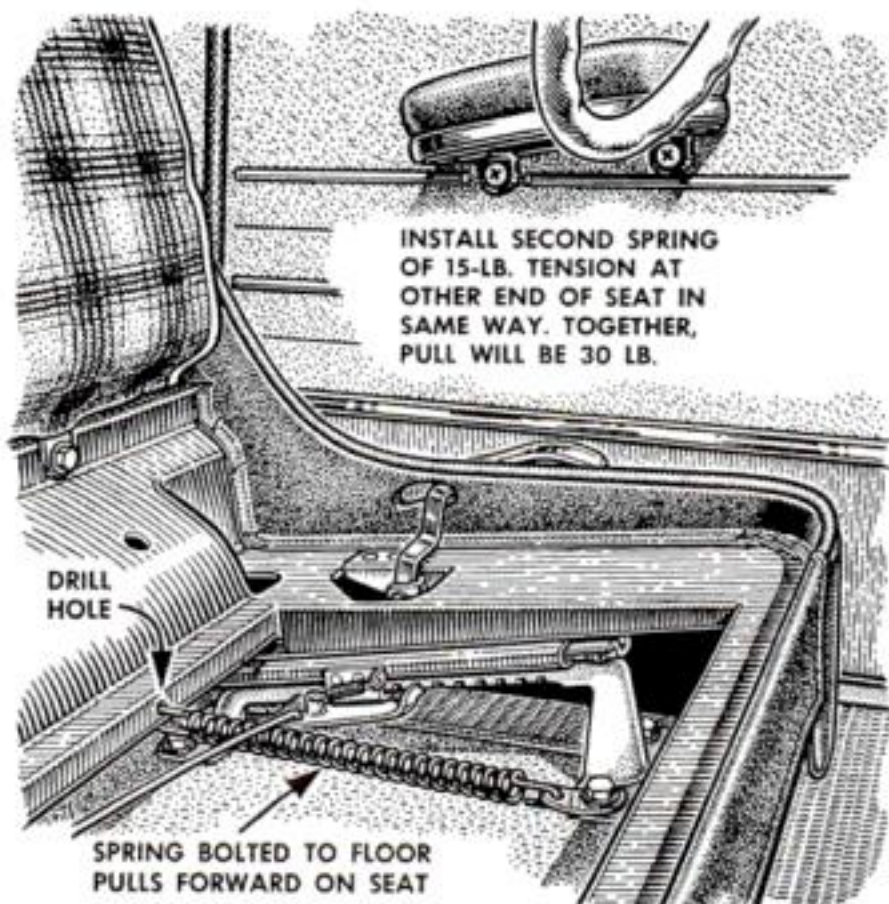
ORDINARY SCOURING POWDER

To clean metal trim and wheel disks made of stainless steel, kitchen scouring powder is best. If a scouring pad must be used to remove dirt, be sure it's a stainless-steel pad, not ordinary steel wool which shreds and causes rust stains.



MAP GLUED TO WINDOW SHADE

A large map that is referred to frequently can be made instantly available by pasting it to a window shade. Use flexible cement or photo-mounting tissue. Hang the roller on shade brackets in a place where it can easily be pulled down.

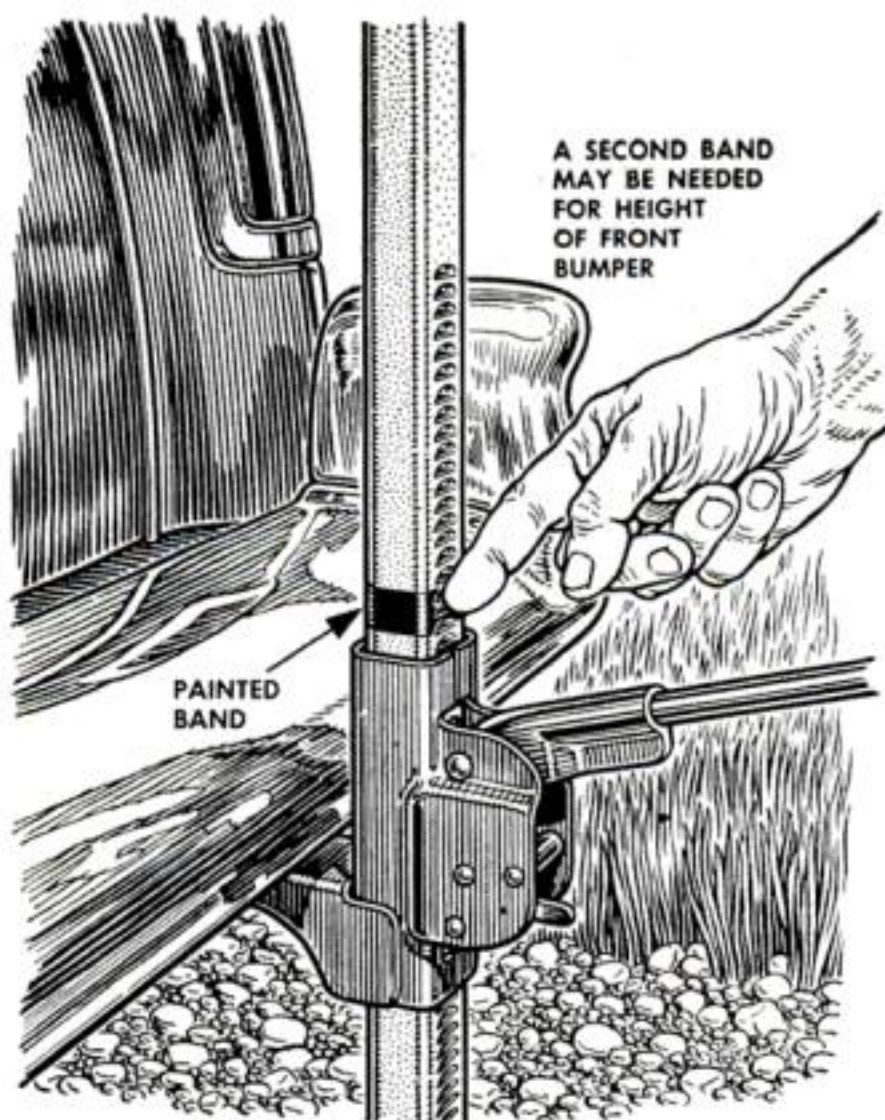


INSTALL SECOND SPRING OF 15-LB. TENSION AT OTHER END OF SEAT IN SAME WAY. TOGETHER, PULL WILL BE 30 LB.

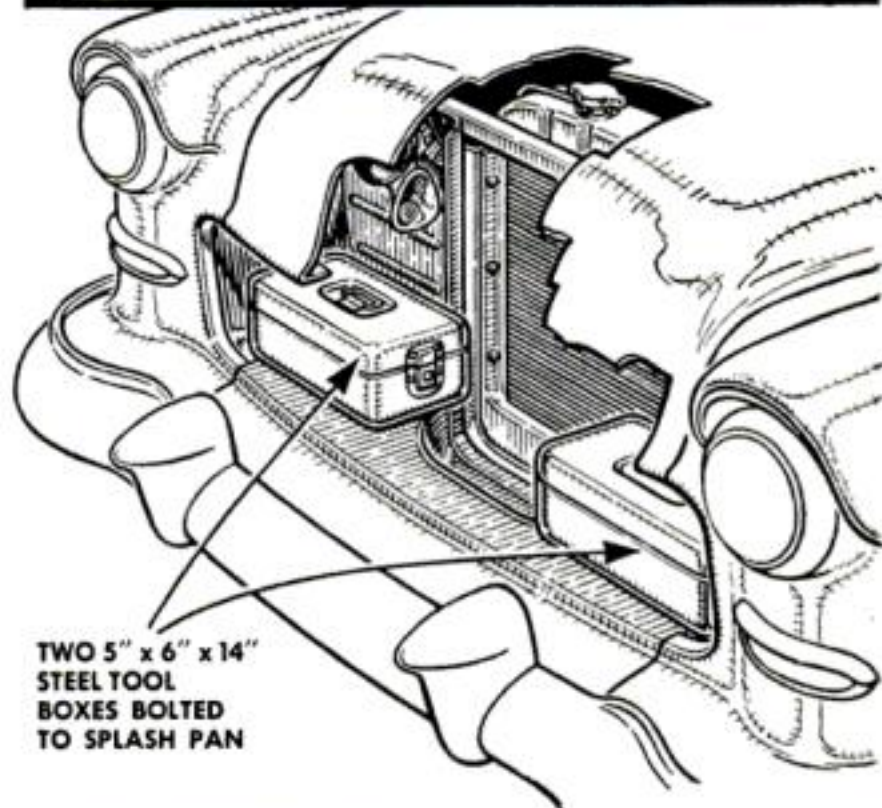
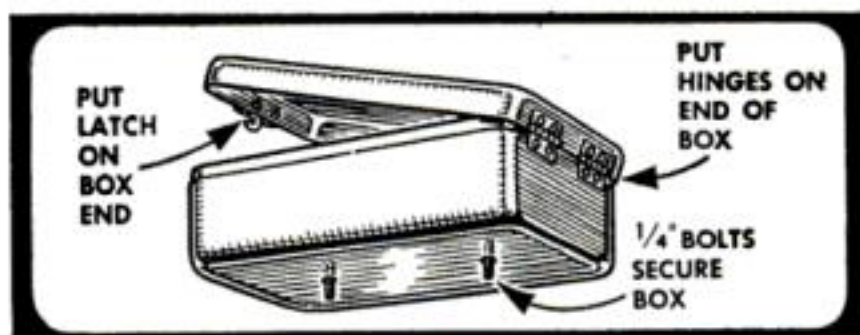
DRILL HOLE

SPRING BOLTED TO FLOOR PULLS FORWARD ON SEAT

Adjusting the front seat is easier for a short person if a pair of screen-door springs are attached to pull it forward when the lock is released. A tall driver can readily overcome the spring tension and push the seat back again.



A mark painted on your bumper jack will tell you quickly just how high to raise the car to clear both the flat and the inflated spare. On some cars, two height marks may be needed, one for jacking the front end and one for the rear.

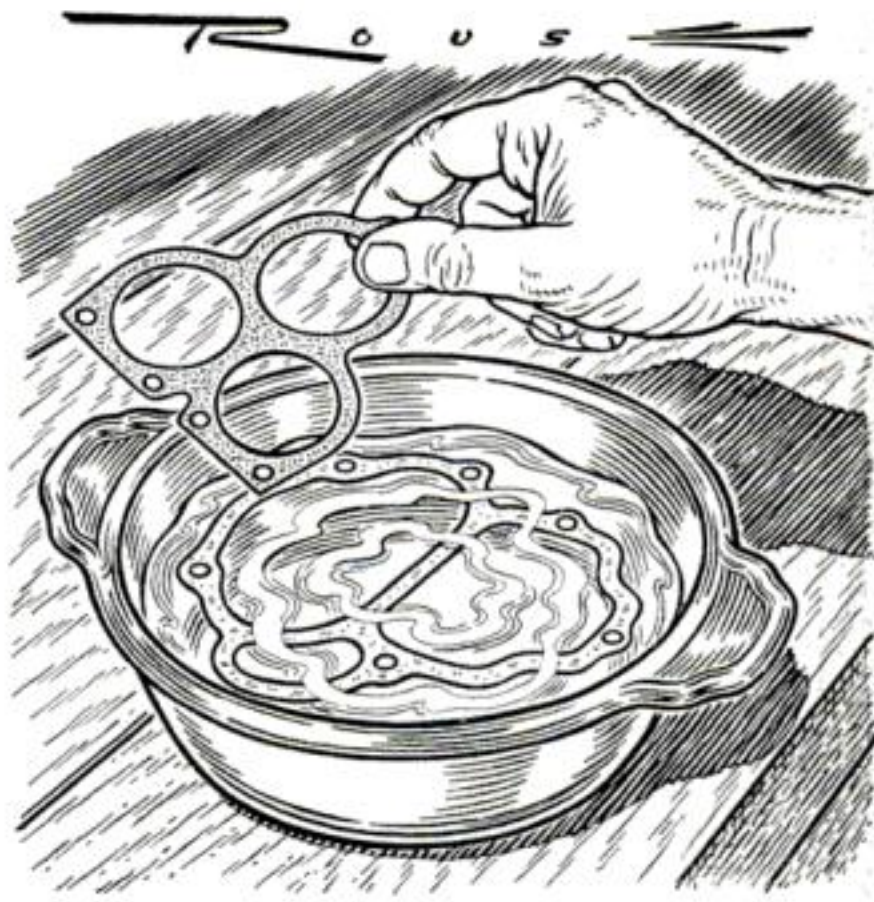


TWO 5" x 6" x 14" STEEL TOOL BOXES BOLTED TO SPLASH PAN

Extra storage space for tools, oil, flashlight and spare parts can be obtained by bolting a steel tool box behind the grille on each side of the radiator. Be sure to locate the boxes so they can be reached easily and do not obstruct the radiator.



If static electricity gives you a jolt each time you touch door or window handles, apply a coat of thinned white shellac over the metal. The shellac will act as insulation and, incidentally, will protect the metal handles and keep them bright.



When re-using gaskets after minor carburetor repairs, soak them in water or kerosene while you work on the assembly. The fluid causes the gaskets to expand and their fibers to fluff up to full thickness. Treat new gaskets the same way.



Instead of looking at the service manual, Gus reached for the phone and began to dial.

By Martin Bunn

“YOU'RE no better'n the others, Gus Wilson!” Silas Barnstable stormed, shaking his fist at the proprietor of the Model Garage.

“Just because I bought a big car, you ain't gonna gyp me into buying high-priced parts. Big car, little car, the parts are all the same. You mechanics just give 'em different numbers so's you can charge more!”

Gus sighed. He knew that many people believed, like Silas, that manufacturers gave identical parts different numbers and descriptions so they could be sold at higher prices.



Gus Learns to Count

"I don't know why I even come here, Gus. I can do lots better at that new auto-parts store in Brownville."

"Well, maybe you ought to try them, Silas."

"Don't think I didn't! But they don't have the part I needed. Burglars cleaned them out yesterday. 'Sides, I'd have to put the thing on myself."

"How about Stafford's Garage out near the shopping center?" Gus offered, playing up to the old character.

"Hmmp! Likely as crooked as you."

Gus grinned. "Sure would like to show you the facts about parts interchangeability, Silas, but Bert Wheeler is bringing in one of his motel guests who has car

trouble. In fact, here they come now."

As Wheeler pushed a 1954 Lincoln into the shop with his station wagon, Silas went over and peered in at the thin-faced driver of the first car. "You watch this here Wilson. He's out to clip anybody with a big car!"

The driver's eyes narrowed. "Look, Dad, you mind your business, I'll mind mine."

"Young whipper-snapper!" Silas whirled and headed out of the shop.

Big Bert Wheeler laughed. "Same old Silas, eh, Gus? Oh—this is Bill Carver. Looks like his do-it-yourself auto repair got him in trouble."

"What seems to be wrong, Mr. Car-

ver?" Gus asked, eying the big sedan.

"Well, it just won't run since I replaced a worn distributor this morning."

"Timing, maybe?" said Gus, lifting the hood. "Just putting in a new distributor isn't enough. Now if you'd had a timing light . . ."

"Got one, mister." Carver pulled out a fancy pistol-gripped timing light. "But I couldn't get the car running long enough to use it."

"Well, I have to get back to the motel," Wheeler announced. "Stop in next time you're around, Mr. Carver."

GUS looked over the distributor and prepared to check the timing. He noted new spark plugs, a new fuel pump and shiny new carburetor.

"You keep your car in good shape," he commented. "This shouldn't be tough."

"That's good, because I'm in a hurry." Carver lit a fresh cigarette with the stub of the old one.

Bent under the hood, Gus positioned the crankshaft pulley to the timing mark and jiggled the distributor rotor in position to fire number-one cylinder.

"Hit the starter, Mr. Carver."

The engine caught instantly. But the smile on Gus's face changed to a frown as the engine backfired, jerked and died.

"That's just what it did for me," the man said. "Better try something else."

Gus nodded. "If I hadn't just set it up, I'd swear it was out of time. Hit the starter again."

After a grinding start, the engine ran about 50 revolutions, only to spit back through the carburetor and die.

Gus gave Carver a puzzled glance. "This sort of thing happen before you put in the new distributor?"

"No, it ran just fair. Good as it could, I guess, with a worn unit."

Gus hauled out his pipe, filled it, struck a match and began puffing deliberately. If the timing gear had somehow jumped a tooth, it would be a little out of time—*always*, he reasoned.

He checked the fit between the distributor neck and the hole in the block. No play there. Peering through the open hole, Gus had Carver run the starter as he watched the slow rotation of the camshaft pinion. The gear looked perfect, the rotation smooth. There must be something wrong with that distributor, Gus

figured, if the car had run even reasonably well with the old one.

Picking up the new unit, Gus fingered the drive gear, watching the points open and close. Crankshaft to camshaft, he thought, camshaft gear to distributor drive gear. Distributor to plugs. Hold on!

Gus quickly replaced the distributor. The engine caught, then died, true to form.

"Doesn't look like we're getting anywhere," Carver said impatiently.

Paying no heed, Gus hooked the timing light into the ignition circuit. As Carver ran the starter, Gus held the flashing tube close to the timing pointer on the engine block. In the light of each successive flash, he watched the mark on the pulley creep up toward the pointer. Suddenly the engine started, ran roughly, smoothed out, and died as the timing mark disappeared. Two more trials proved his curious hunch.

Gus frowned. It was like a cycle—a definite cycle. That could mean only one thing. Sounds crazy, he thought, but . . .

Inspired, Gus removed the distributor again. "Have to check my service manual," he said, walking into his office.

"Maybe the old man was right about you and big cars," Carver called.

But instead of looking at his manuals, Gus reached for the phone and dialed.

AS STAN HICKS, his assistant, entered the office, Gus hung up, mumbling ". . . 12, 13, 14. Well I'll be dog-goned!"

"What's up?" Stan asked.

"Monkey business, Stan—and I just learned to count!" He scribbled a number on a piece of paper. "Drive over to the Lincoln-Mercury Garage and pick up this part. And hurry. Use the side door and don't let that fellow in the Lincoln see you bring it back."

Going into the shop, Gus spoke to Carver. "This will take a while."

"How long?" Carver snapped, looking at his watch.

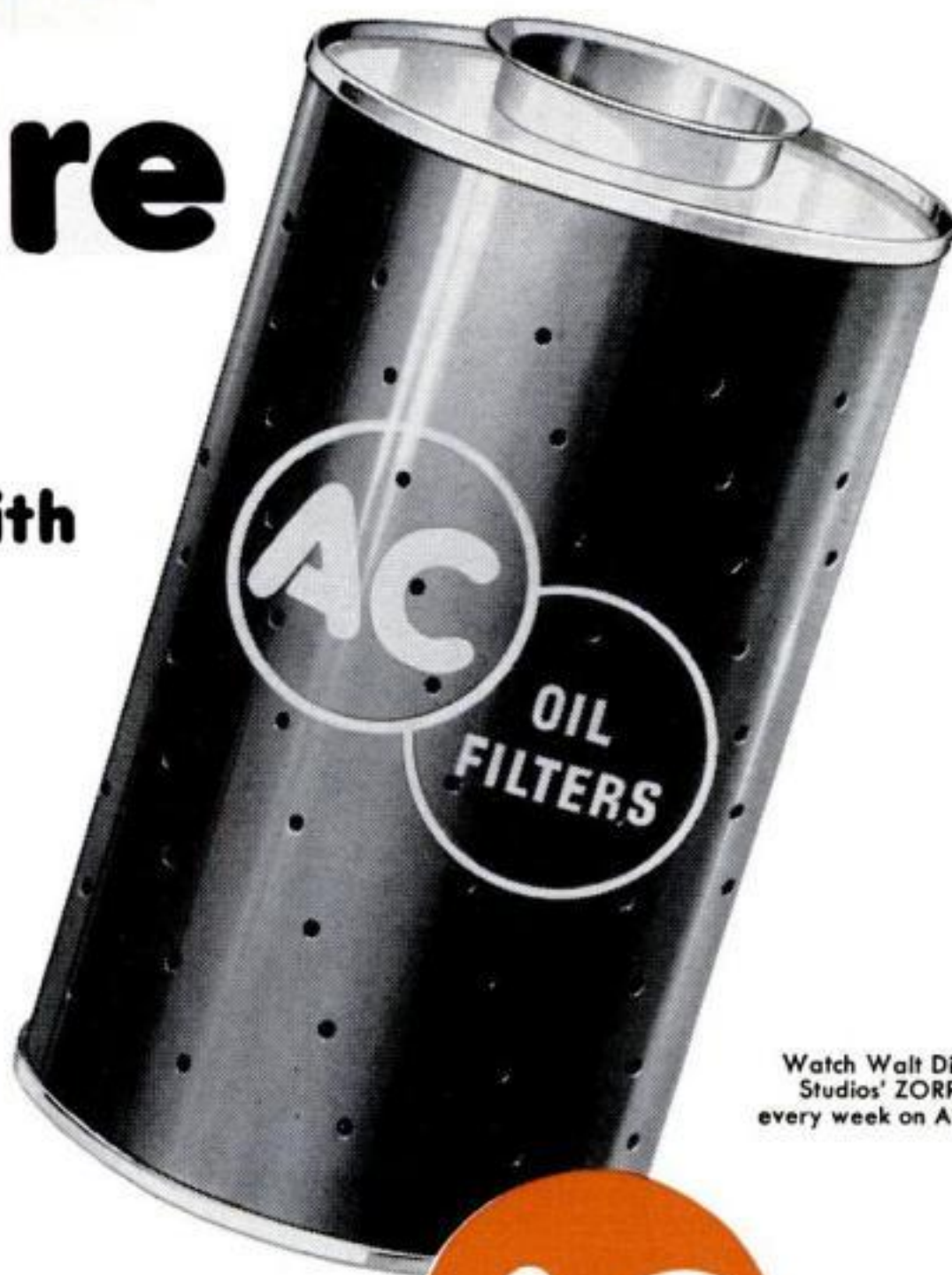
"An hour, maybe."

"I'll grab a bite down at the diner," Carver said, pulling a bill from his pocket. "I'll be back in 20 minutes, and here's 20 bucks that says you'd better have it done by then."

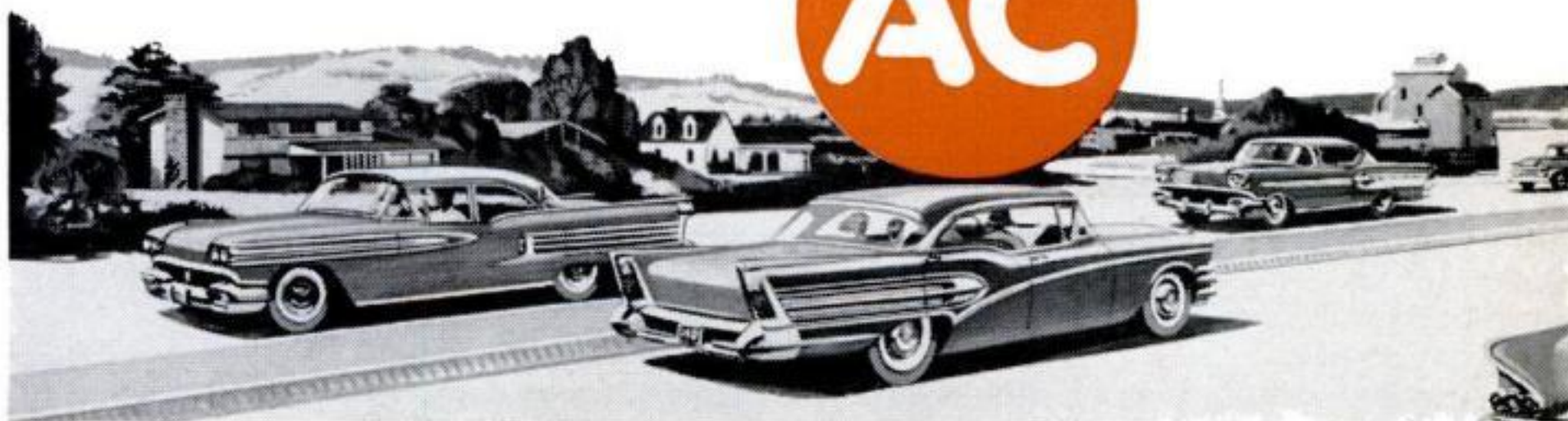
Gus moved fast. Ignoring the engine compartment, he jumped on the rear

Auto Care

starts with



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Auto Care can prevent costly engine repair! Modern engine parts are as precisely machined as a fine watch. They deserve the protection of a new oil filter at least twice each year. An AC Oil Filter cleans all of the oil in the engine every 30 seconds at normal speeds—protects

the precision parts from dirt, dust, grit and bits of metal as small as 1/100,000th of an inch. ACs are factory-installed on more new cars than any other make. Have an AC dealer change your oil and install an AC Oil Filter, too! Remember—Auto Care starts with AC!



AC SPARK PLUG  THE ELECTRONICS DIVISION OF GENERAL MOTORS

Trapper Says:

"CHANGE OIL AND FILTER, TOO!"

bumper. Then, with an expression of satisfaction, he took the distributor to his bench arbor press and went to work.

Stan came in with a small package.

"Wish you'd tell me what this is all about, Gus. Something wrong with that new distributor?"

"About as wrong as anything could be."

When Carver came back, Gus was fin-

"What's the story, Mr. Wilson?" the reporter asked.

Gus told how Carver had come to him for help. "I was stumped. All the clues pointed right to the brand-new distributor. This screwy run, not-run sequence was a definite cycle. Then it hit me. The only thing it could be was gearing, a wrong gear ratio somehow.

"I called the local Lincoln dealer. The part number I gave them was for a Mercury, not a Lincoln distributor. They also told me Lincoln uses a 15-tooth drive gear. The Mercury one is almost identical, but uses a 14-tooth gear. Although the difference wasn't enough to keep the gear from meshing, the fast ratio made the engine repeatedly run itself out of time."

The reporter was taking notes as Gus continued.

"Then I remembered hearing about the Brownville auto-parts burglary. Things began to add up—new parts on his car, sagging rear springs. The distributor made me still surer."

"How so?" Jerry asked.

"Well, I figured nobody in his right mind would sell a Mercury distributor for use on a Lincoln. But a person could steal one—it looks identical. Then I sent Stan for the right 15-tooth drive gear, put it in, let him go, made a fast call to the Brownville store to ask if a timing light and a Mercury distributor were among the missing items—they were—and figured you'd still be able to nab him."

"And that we did," Jerry said as O'Shea focused his camera.

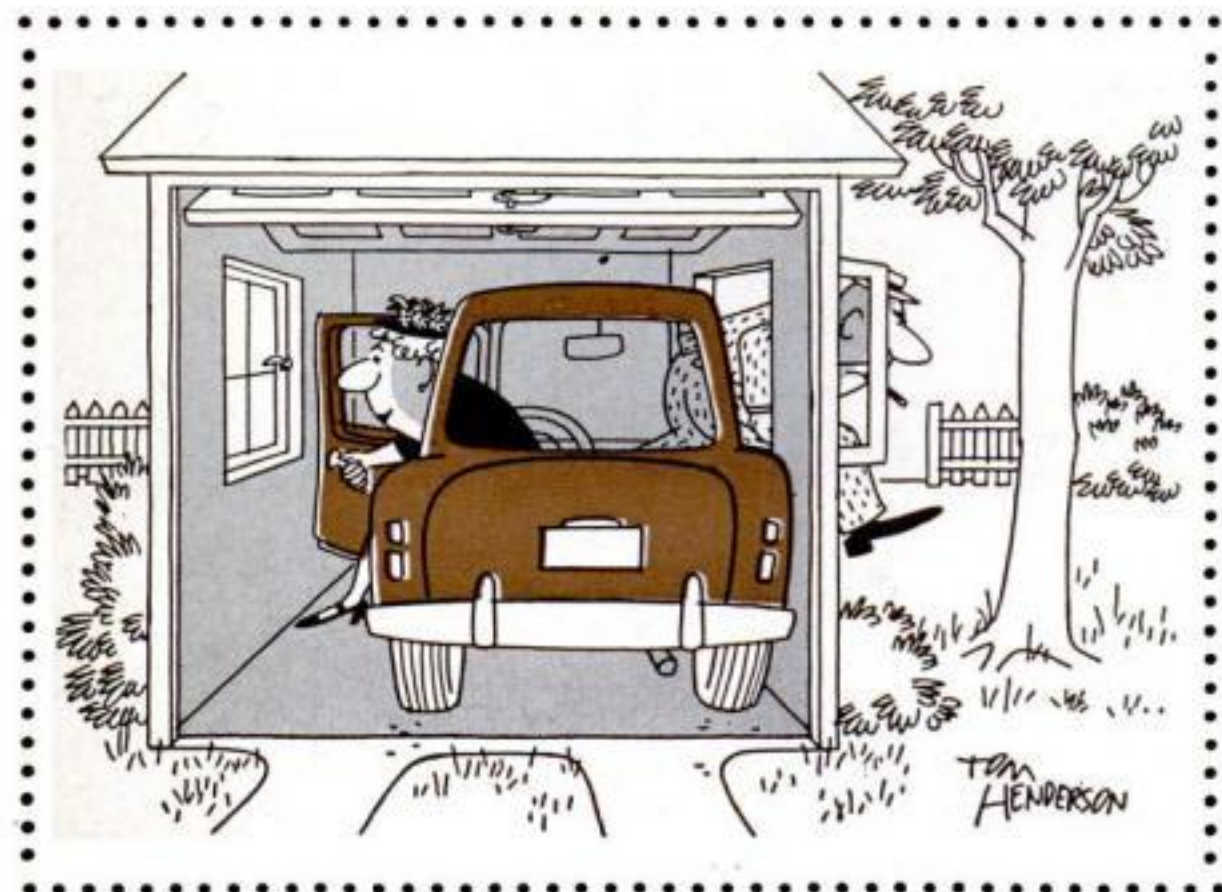
"Hold it, you two. And Mr. Wilson, pick up that wrong gear, will you? I'll make the front page with this."

"Okay," said Gus, taking up the pose. "But how about sending a clipping of your story to a friend of mine?"

The bulb flashed. "Sure. A relative?"

Gus grinned. "Nope. Just a thorn in my side who should learn what can happen to a fellow who thinks all auto parts are alike—Silas Barnstable."

Next Month: Gus mends some fences.



ished and the car was running. Without a word the man got behind the wheel, backed out and took off.

Gus dashed into the office and picked up the phone. Stan followed him and heard his boss conclude, "... that's all I wanted to know."

Gus dialed another number. "Police Barracks? Officer Corcoran there? ... Jerry? This is Gus Wilson. There should be a 1954 Lincoln, dark blue, heading out of town on the east highway. License is 16-3390. Driver is blond, in his mid-twenties. Name's Carver. I'd suggest you pick him up for questioning about that auto-parts burglary over at Brownville." Gus paused and listened.

"Sure I'm sure. If you don't find enough evidence in the trunk to convict him, I'll eat an inner tube."

ABOUT an hour later Jerry Corcoran and a young man carrying a press camera walked into the Model Garage.

"Gus, this is Dan O'Shea, a reporter from the Brownville Times. He was at the barracks when we brought Carver in. The fellow had enough stolen auto parts and accessories in his trunk to start a garage."

A passing fad, or the promise of amazing new home entertainment? Before you buy, you should know—

**Hi-Fi
and
Electronics**

The Facts About Stereo Hi-Fi

By R. S. Lanier

AN EXPRESS train comes whistling in through your front door. You flinch as a jet of steam hisses past your chair and wheels clank over the rail joints at your feet. Then, with a whistle

blast trailing off into the distance, it fades out the window.

This is a trick with sound waves that will be repeated thousands of times in hi-fi showrooms and devotees' living rooms this fall. Although frankly a stunt—stereo sound has more rewarding uses—it's a

Quick answers to stereo questions

What is stereo?

It is sound in three dimensions. It adds the illusion of depth, direction and movement to reproduced sound. Instead of listening to music from a loudspeaker you seem to hear it coming from instruments spread out around the room.

How is stereo achieved?

Two sound channels are used instead of the usual single channel.

How can I get stereo at home?

From the new stereo records, stereo tape recordings or in some areas over AM-FM radio stations.

Will the stereo records play on my old machine?

Not without modifications. You'll need a stereo pickup, a second amplifier and a second loudspeaker.

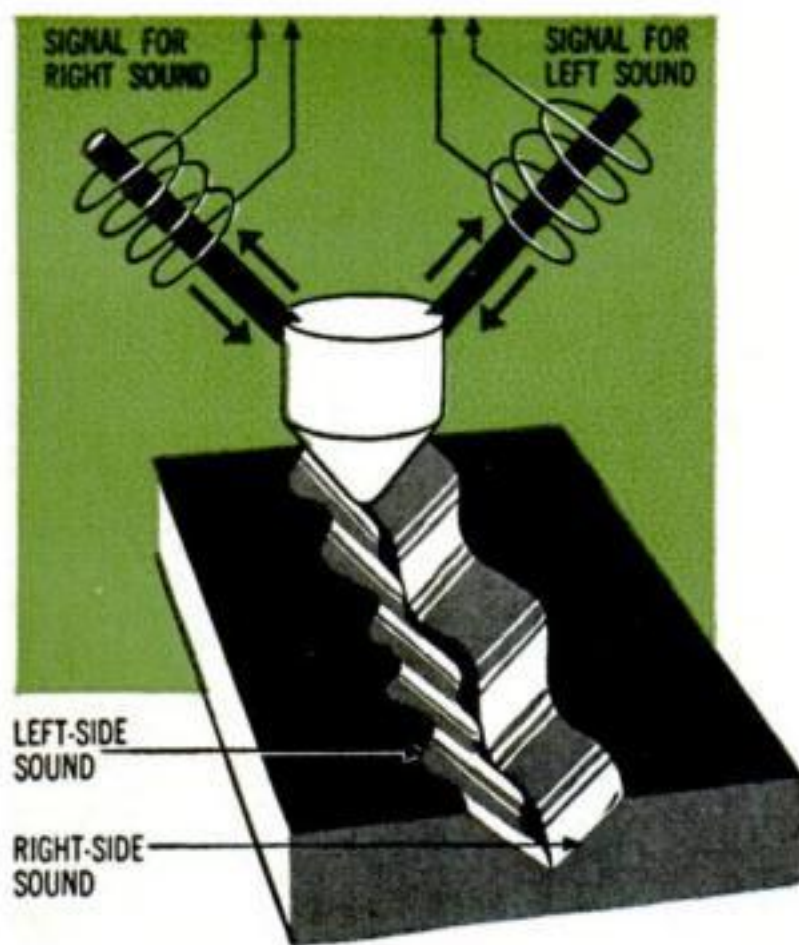
Must the second amplifier and speaker exactly match the originals?

Ideally, yes. Practically, the second channel can get by with less bass. The middle and high frequency responses should match closely, however.

Will standard LP's play on a stereo machine?

Yes, but of course there will be no stereo effect. They'll sound just as they do on any other record player.

How a stereo disc packs two sound tracks into one groove



EACH SIDE OF GROOVE on a stereo disc has separate sound track. This gives the two separate sounds needed for stereophonic reproduction. Sketch at left shows the left sidewall with a treble note (hills and valleys close together), while the right sidewall has a low, bass note (hills and valleys far apart). Ups and downs of left wall push stylus along line at 45 degrees to record surface and inclined upward to right. Right sidewall pushes stylus up and down on line at 90 degrees to first line. When both walls have music, as in sketch, the two pushes produce one combined stylus motion along a path somewhere between the 45-degree lines.

In the pickup, two electrical generators, highly simplified in the sketch, connect to the stylus. The left generator responds only to motion on one line, the right generator to motion on the other line. On intermediate "combined" motions, each generator responds only to the component of motion along its line, thus separating the two sound tracks for separate reproduction in the amplifier and speaker channels.

symbolic express train that the recording and hi-fi industries hope to ride to the biggest sales boom ever.

Stereo may be a controversial subject from the consumer's viewpoint but there are reasons for the industry's optimism:

- Recent developments in records, tape and radio promise home stereo sound in the average buyer's pocketbook range.

- It's something new to feed the home-entertainment appetite that has become a little jaded—where buying new equipment is concerned—with plain hi-fi and television.

Stereophonic sound, at its best, can be an excitingly new listening experience. Installations are popping up everywhere: from jukeboxes to the sound systems in deluxe airliners. And soon it will be making a bid for your home-entertainment buck. But before you toss out your present rig or plunk down anywhere from \$200 to \$2,000 for a whole new stereo outfit, here are some facts you should know that you won't find in the wildly enthusiastic publicity that is being turned out to promote stereo:

- Stereo does not replace high-fidelity. It can only enhance it. You still need the same caliber of distortion-free performance. Avoid machines that try to sneak by under the stereo banner alone.

- Stereo records must be chosen with care. To get an early ride on the stereo boom, some recording companies have rushed records on the market before their stereo techniques were perfected.

- Good stereo must be set up properly for each room. Single-box packaged units will be handicapped here. You'll do better with separate speaker systems in separate enclosures.

- The stereo pickup you choose can make a big difference. This has been the toughest part to bring up to the quality level of present monaural units. Take the time to compare the various makes available to you.

- Your present hi-fi rig (either ready-made or components) can become half of your stereo system.

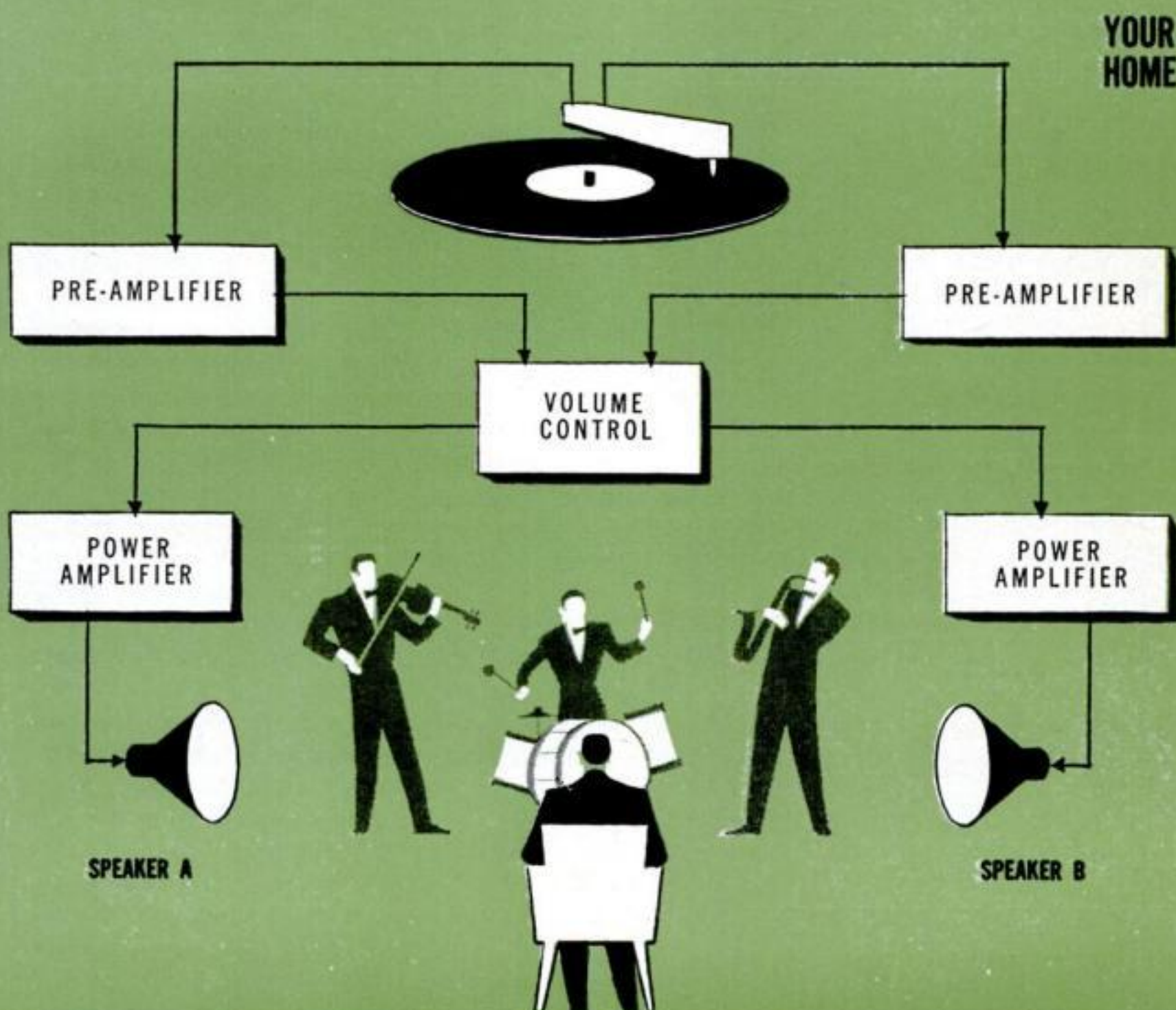
What is stereo? Stereophonic reproduction, as now offered, uses two complete side-by-side channels of recording between the original sound and your living room. Stereo calls for doubling everything, starting with the microphones in the recording studio. You need two sound tracks on the disc or tape, a pickup that responds individually to each track, two amplifiers, and two separate speaker systems placed some distance apart in your living room.

Two of everything provides independ-

A stereo disc seems to bring the musicians right into your home



**RECORDING
STUDIO**



**YOUR
HOME**

How to place the speakers



STEREO LISTENING must be in area crossed by beams of highs from both speakers. Lines in drawings show spread of highs.



NARROW-BEAM HIGHS, produced by some speakers, restrict listener to small area. Place speakers to spread highs out.



HIGHS CAN BE BOUNCED OFF WALLS of room to get more spreading. Experiment in each room to find the best position.



DISTANCE BETWEEN SPEAKERS should be half to three-fourths that from speakers to listener for good channel separation.

ent channels to deliver slightly different images of the original sound into your listening room. In effect this system imitates what happens when you hear live sound face-to-face. Whether you're at a concert, the opera or standing on the right-of-way when an express passes, each of your ears gets a slightly different impression of the same sound. These tiny differences when compared in your brain's hearing center add up to a sense of breadth, depth, distance and direction of the sound. Cover one ear and all the sensation you have left is that of pitch, time and intensity.

Who listens with one ear? Of course you usually have both ears open when you listen to any radio or record player. The difference is that all the sound you hear is funneled through a single channel up to the point that it leaves your loudspeaker. After the sound gets out into the room, your ears can display their fantastic teamwork—too late. They come up with the information that the sound is exactly as far away as your loudspeaker over in the corner; that somehow a 100-piece orchestra has managed to squeeze inside that little box.

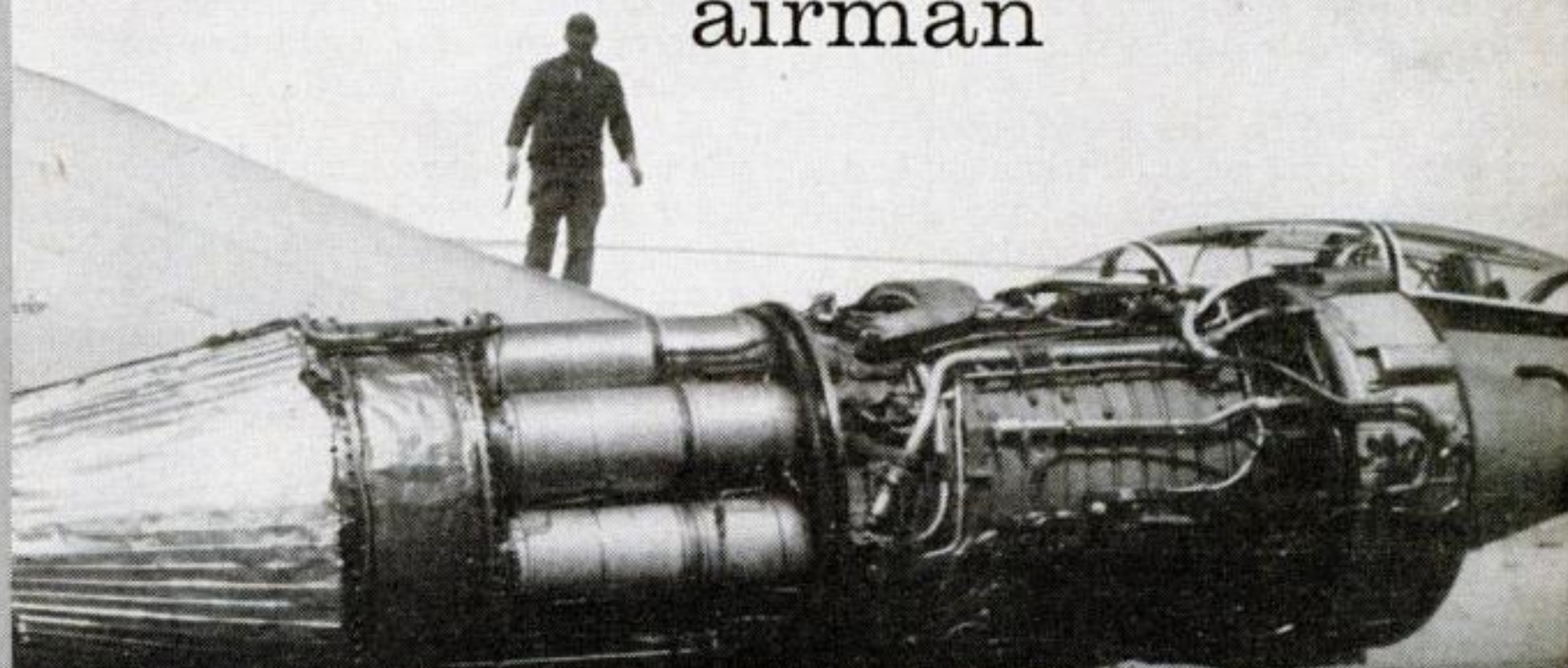
There's the rub. Monaural hi-fi can do a magnificent job of reproducing a solo. Many experts, in fact, prefer it over even the best stereo for this. But all the tricks the recording engineers have used to get a feeling of space on a single-channel record avail little. You are left with the notion that you are hearing an orchestra through a hole in your living-room wall.

Present two-channel stereo can't give you genuine two-ear hearing, but it does take a big step in that direction. By bringing the sound from separate points in the recording studio over separate paths to your listening room, it gives your two ears more information to work with. If it were not that the two sounds get mixed together a bit after they leave the loudspeakers, the illusion would be almost perfect. As it is, even this compromise stereo can give startling effects. For instance, it can:

- Seem to push back the walls of your room to concert-hall size.
- Spread the sounds of the different instruments around the room—violins on the right, drums to the left rear, soloist out front.
- Recreate the movement of sounds:

The new age of space is here...

and the future
belongs to the
airman



You have read about the early Age of Flight...grown up in the Jet Air Age. Now, as a young man, you stand on the threshold of a new age in which man will conquer outer space. It will be the age of trained technicians—those who have backgrounds in rocketry, jet propulsion, electronics, mechanics and allied fields. And nowhere else is such training so available or so complete today as in the U.S. Air Force. Consider this fact as you plan your future. By joining the Air Force, you will, of course, meet your military obligation. But much more important, you will prepare yourself for unlimited opportunities in the new Age of Space. See your local Air Force Recruiter today—or mail the coupon.

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You can hear a military band march by your armchair reviewing stand.

Stereo discs—an uneven flood. It's the stereo record that has really triggered the current furor. Records are cheap and familiar to handle. They promise the big mass market previously denied to tape stereo by the fancy price tags. The record industry is betting heavily on the discs—there's a flood of them pouring from the presses. But . . . you have to pick and choose carefully among them. Quality varies widely. Some give little or no stereo effect, others have fuzzy highs or weak bass. Noisy surfaces and high distortion are all too common. Fortunately, there are some excellent examples, too. And these amply justify the praise of the enthusiastic converts.

A big reason for the uneven quality is that stereo recording is largely a cut-and-try proposition. It's more art than science at this stage of the game. And the recording technicians need more practice with this new art before they can produce a winner every time.

Ping-pong stereo. Often the recordists strive too mightily for stereo effect and the music comes apart at the seams. They want to grab the customer by the lapels and say "Hey, this is spectacular." It may be—on first hearing. But the ping-pong effect, as the sound bounces back and forth between speakers, soon wears its welcome thin to most listeners.

Good stereo should have "center-fill." You shouldn't be aware of the sound coming from either one speaker or the other. The instruments should seem to be spread out in space.

Get the right equipment. Many of the mistaken ideas about stereo equipment are fostered by overeager salesmen. The facts are these: The only part that need be made especially for stereo is the pickup cartridge. You don't have to discard your present rig. There are no mysterious, hidden advantages to buying gear with a "stereo" label.

Whether you have a ready-made job or separate components, if you are satisfied with its usual performance, all you need add is a second amplifier and speaker, and, of course, the stereo pickup. There are simple, inexpensive adapters available that provide the needed connectors and ganged volume control. This is not only cheaper, but is likely to give

you better stereo than most of the stereo packages, unless you are planning to spend big money.

If you are starting from scratch, here are some pointers on buying:

- Listen to the way the machine or system reproduces single-channel sound. Ask the salesman to silence first one speaker and then the other. Each channel should give clean, sharp, full-range sound. You can judge this better if you are not distracted by the stereo effect on first listening.

- Listen for turntable rumble. Stereo pickups are more sensitive to mechanical vibrations generated in the rotation of the turntable. Some of the cheaper record changers are not acceptable for stereo.

- Listen to your favorite kind of music for the stereo demonstration. Don't get fooled by tricky demonstrations that may amaze you for the moment. Check for clarity, balance between lows and highs, spread of the instruments, and a general sense of listening comfort with the overall effect.

If you want to stretch out the cost by adding stereo piecemeal, the logical starting point is a second loudspeaker system. You'll be surprised how much better even your single-channel rig will sound with just another speaker tied in.

You can enjoy your investment while you're waiting to add the other parts. This makes more sense for most people than getting the pickup first, as some suggest. It is true that stereo pickups will also play standard LP's. But most pickup engineers will tell you (out of the hearing of their sales manager) that a good monaural pickup will do a better job with less groove wear on standard records than will a comparable stereo pickup. So until you are ready to buy stereo records, you will be wise to hold off on a stereo pickup.

You are the maestro. Good records and fine equipment can still yield disappointing results unless you pay attention to proper speaker placement and balance. Every room is different, and you'll have to experiment to get the musicians to their proper seats. There are rules of thumb to help you get started. The speakers will usually want to be separated by about half to three-fourths of the distance from speakers to listeners. The speakers should be faced so that the

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"GOLDEN CLASSIC"
Model GC-7 (shown above) with .7 mil diamond stylus . . . \$23.95*
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For matchless reproduction, use with G.E.'s new "Stereo Classic" tone arm. Write for complete specifications. Ask for a demonstration at your dealer's soon. General Electric Company, Specialty Electronic Components Dept., Section 82, W. Genesee St., Auburn, N. Y.

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—at a very realistic price!**

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- Consistently high separation between channel signals. (Specifications for Model GC-5).

GENERAL  ELECTRIC

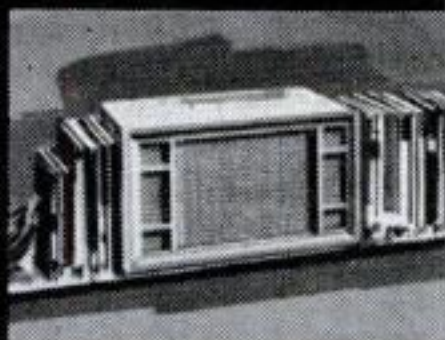
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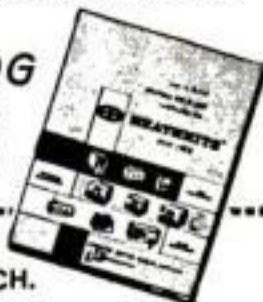


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high-frequency beams overlap in the intended listening area. In some cases, you'll get better results by bouncing the highs off the walls of the room as you might bank a billiard ball off the side cushion.

Before you try your tentative arrangement, you must balance the loudness of the two speakers. A monaural record is best for this. First adjust the balance controls until you hear the same loudness from each speaker when you are sitting in the listening area. Check the accuracy of balance by standing midway between and somewhat in front of the two speakers. If the balance is right, the sound from the monaural record will seem to be coming from a spot in the middle, between the two speakers. If it seems to be off to one side, the speaker on that side is slightly louder.

How about tape stereo? For some six years, now, stereo sound on tape has been a favorite with hobbyists who could afford it. Stereo completely dominates the sales of prerecorded tapes. But this market is comparatively small. Reasons: The tapes are costly, and there's a general suspicion that special skills are needed to operate a tape machine.

The backers of tape have launched a double-barreled attack on these sales blocks. They're getting more music on less tape to reduce cost, and a plug-in tape magazine licks the handling problem.

Third face of stereo. Radio and TV stations are another source of stereo sound although the offerings to date have been meager. First out with stereocasts were the stations with both FM and AM transmitters to provide the necessary separate channels. To hear these, all you need is an AM radio properly located in the same room with your FM receiver. TV stations are getting into the act, too, by using associated or cooperating radio stations to transmit the second channel. But probably the best bet for broadcast stereo is FM multiplex, which is still under development. This system will send out both channels from the same FM transmitter and require a special gadget at the receiver to separate the signals.

Which road to stereo? If you are a dyed-in-the-wool audio fan you won't be happy until you have all three—tape, records and radio. But if your enthusiasm is

[Continued on page 231]

Change For The Better Change To V-M STEREO!



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RUMBLE: — 48 db for 120 cycle rumble when tested on XLP414 test record (recorded velocity approximately 3.4 cm/sec. at 1,000 cycles.)

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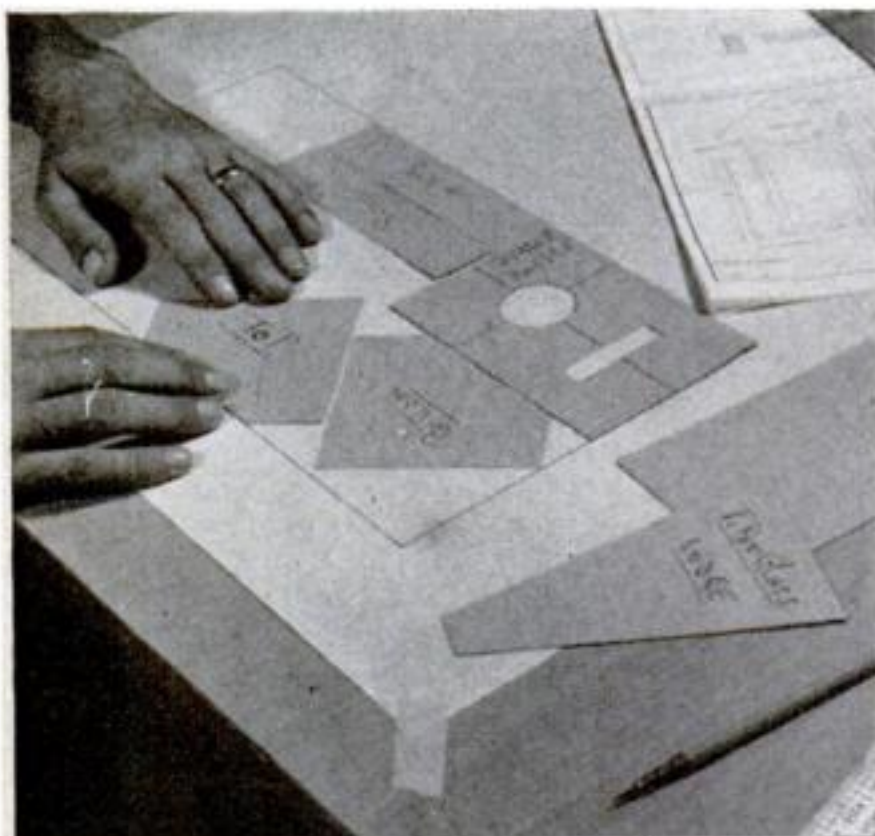
WORLD FAMOUS FOR THE FINEST IN TAPE RECORDERS, PHONOGRAPHS AND RECORD CHANGERS.

OCTOBER 1958 219

What Makes a Speaker Enclosure Good?

By R. J. De Cristoforo and Hubert Luckett

Whether you build or buy one, you'll get best results by making sure about the four major points at right

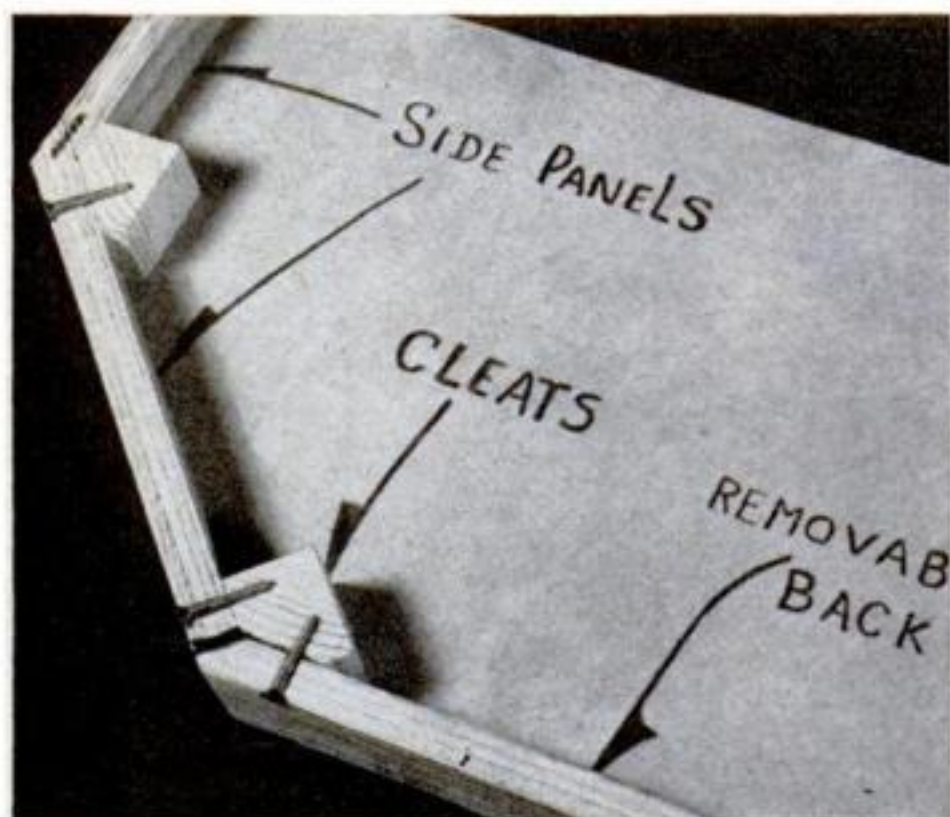


BUILDING AN ENCLOSURE? Cardboard parts scaled 2" to the foot will let you plan most economical use of the plywood panels you buy.

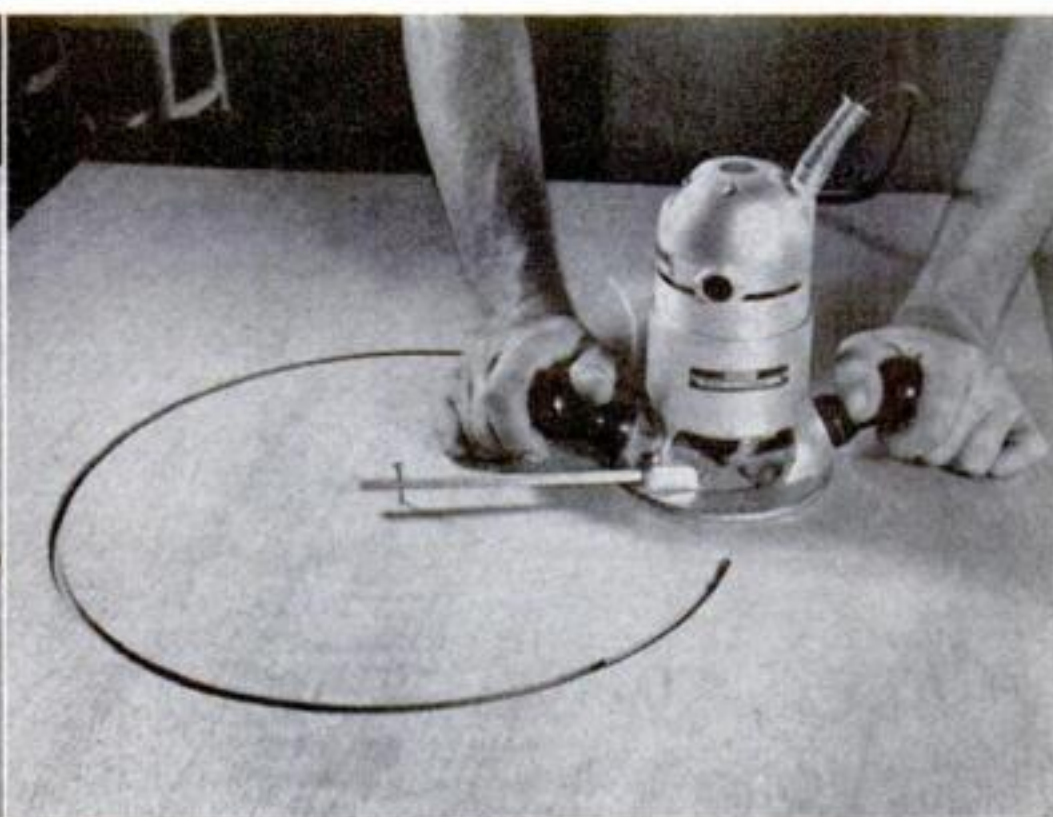
TAKING your first plunge into hi-fi? Want to upgrade your present record player? Going in for stereo? Miffed at the poor sound from your TV set?

If any of these questions hits home, a good loudspeaker enclosure may be the best point to start doing something about it. You can make a modest skill with hammer and saw pay big dividends in better sound quality. We'll show you the construction techniques—the speaker manufacturers will furnish the acoustic designs. Or, if you'd rather buy a ready-made enclosure, you'll get better sound for your money if you know what construction features to look for.

A speaker enclosure should be much more than just a convenient hiding place for the loudspeaker mechanism. But costs



SIMPLE JOINTS like this can always be substituted when plans show fancy joinery. A rubber gasket was used above to seal removable back.



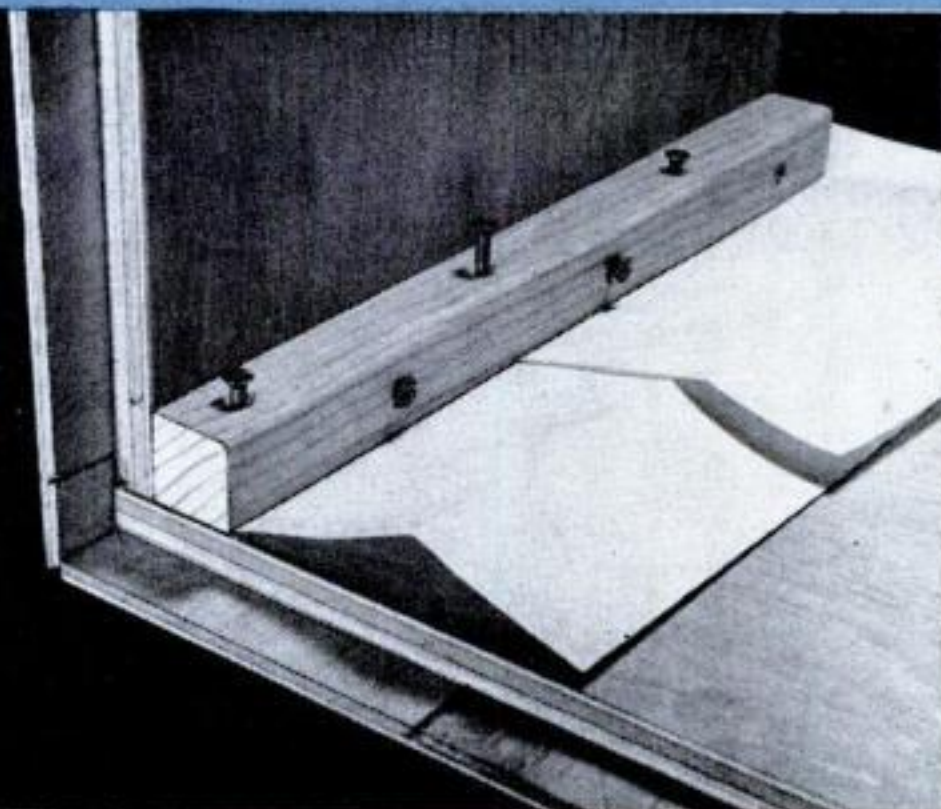
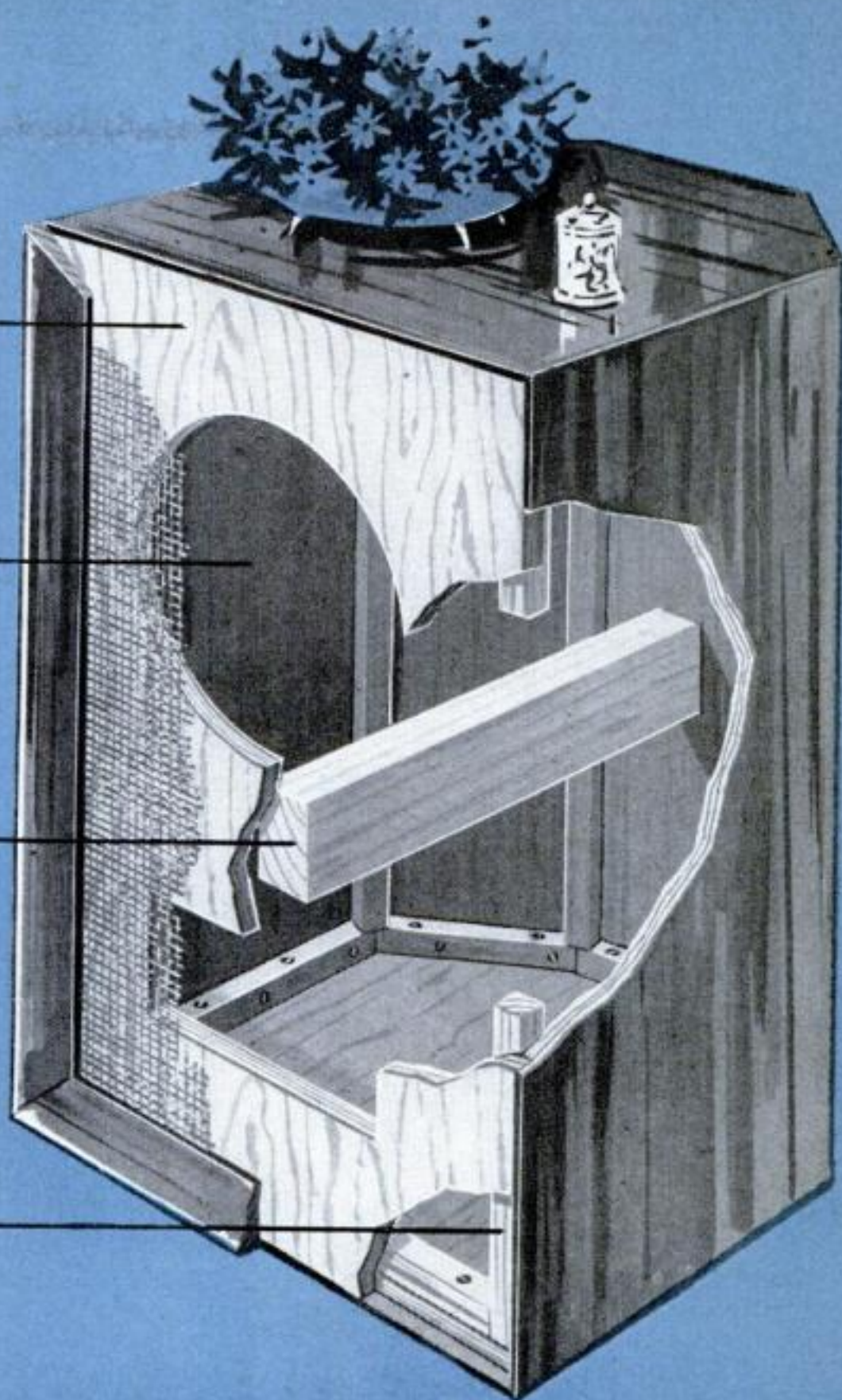
CUT SPEAKER OPENINGS before you begin assembly. A router is the slickest way, but a keyhole saw will do—it just means more sanding.

1 Heavy, rigid panels

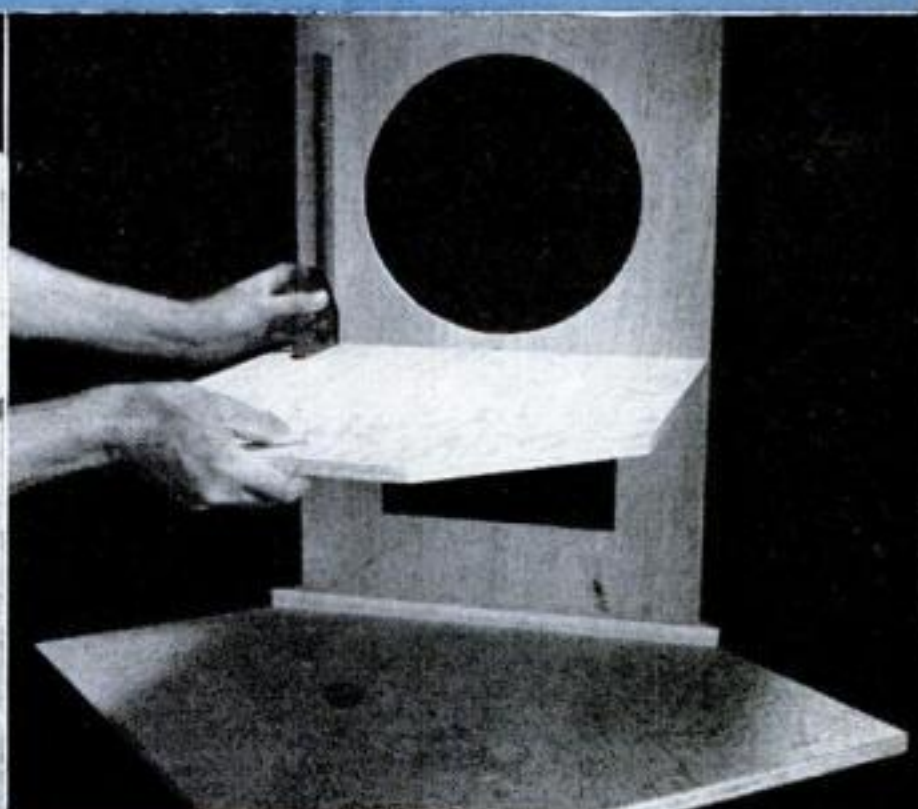
2 Acoustic design matched to your particular speaker

3 Adequate internal bracing

4 Solid, airtight joints

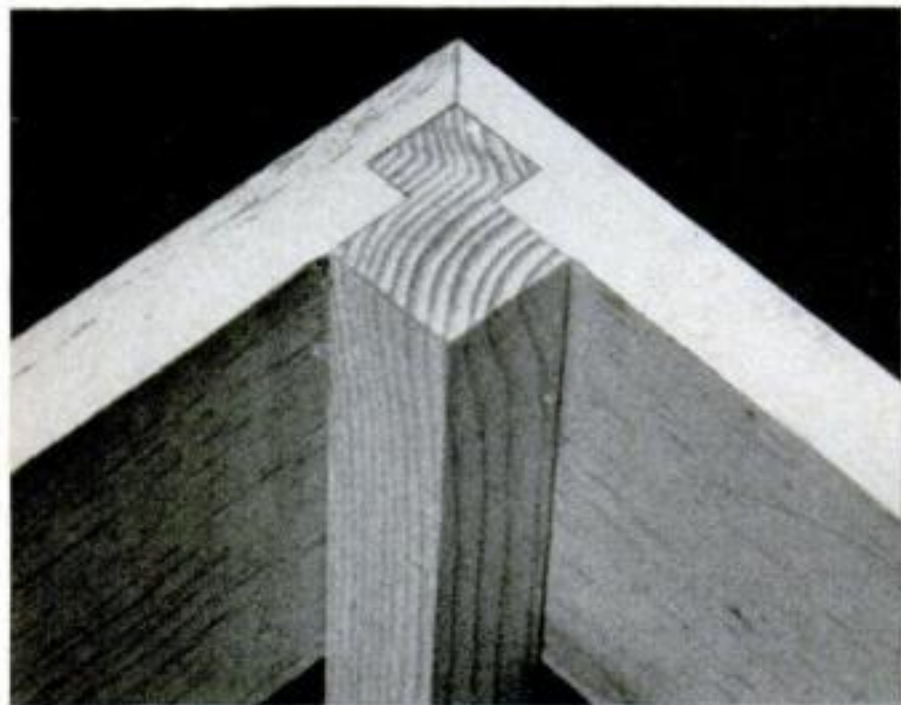


NO CLAMPS ARE NEEDED with this construction. Use plenty of glue and screws. Remove paper before tightening second row of screws.

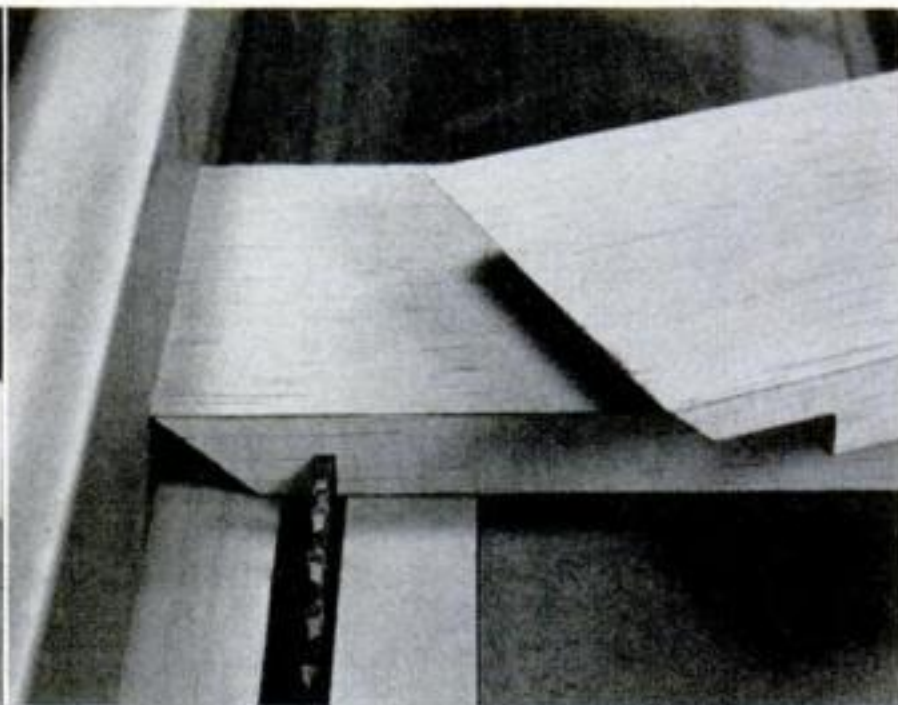


STARTING FROM THE BOTTOM is usually easiest. Use temporary braces to hold parts in place for a "dry run" before the final assembly.

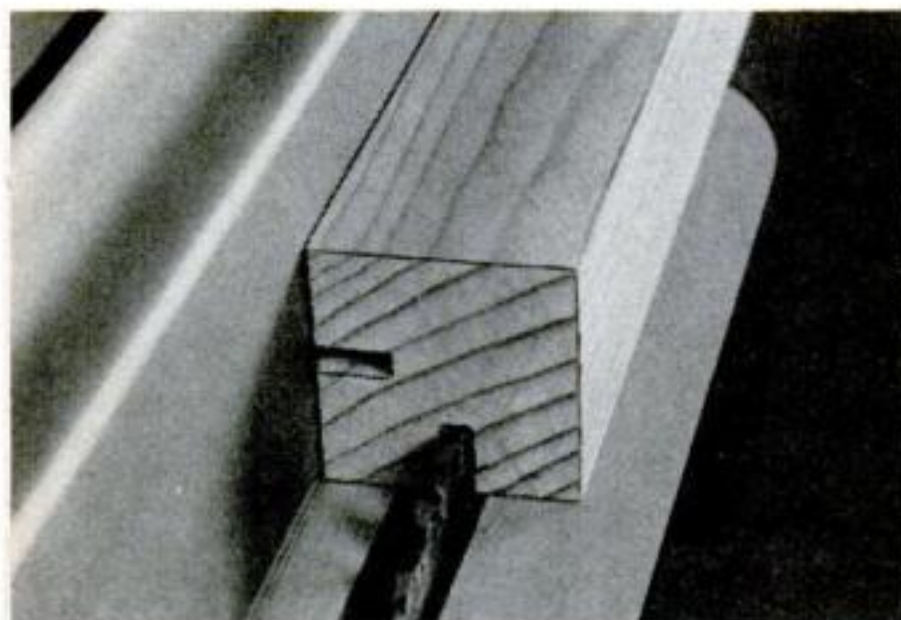
Designed for speaker enclosures, this new joint grips hard



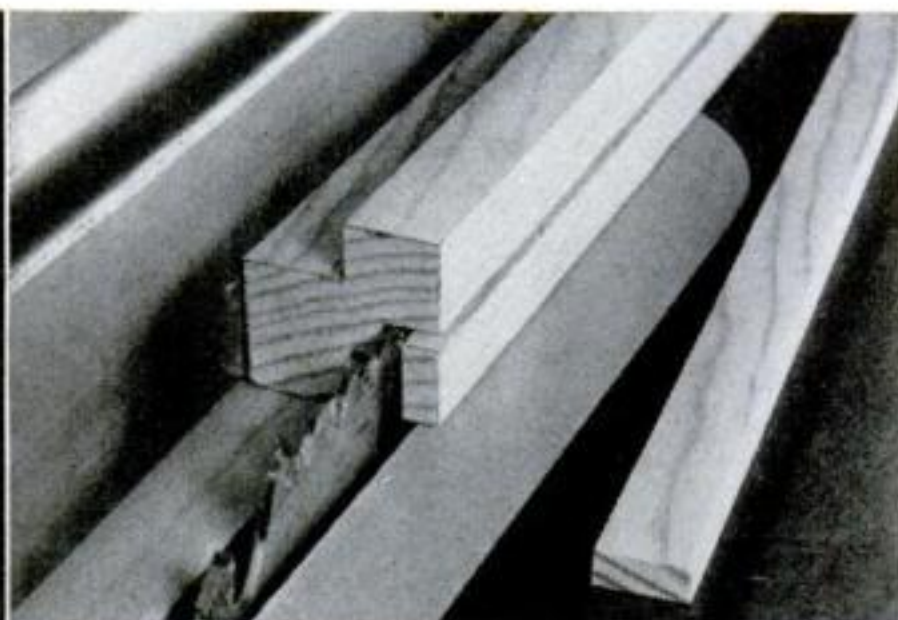
EASY TO MAKE, joint shown in above setup is ideal for enclosures because of its rigidity. Outside miter makes it perfect for finishing fancy plywood—edges are completely hidden.



CUT ORDINARY MITERS FIRST, then use rip fence as a guide to make a cut half the thickness of the stock and $\frac{3}{4}$ " from the base of the miter. Remove waste between saw cut and miter base.



MAKE CLEAT-SPLINE from $1\frac{1}{2}$ " square stock, cut to the length of the panels to be joined. Make cut $\frac{3}{4}$ " from edge on adjacent sides and as deep as the rabbets on the mitered pieces.



LAST TWO CUTS remove waste stock and leave a double-diamond shape. Plenty of glue surface and ample room for screws make this an exceptionally strong, airtight joint.

often push the makers of ready-made hi-fi and TV sets into providing little more than that. Even buyers who assemble their rigs from separate components frequently cancel much of the quality they have paid for by mounting their speakers in any box or cabinet that happens to be handy. The speaker and its enclosure must work together as a team to get the best results. The enclosure is actually a functioning part of the speaker system.

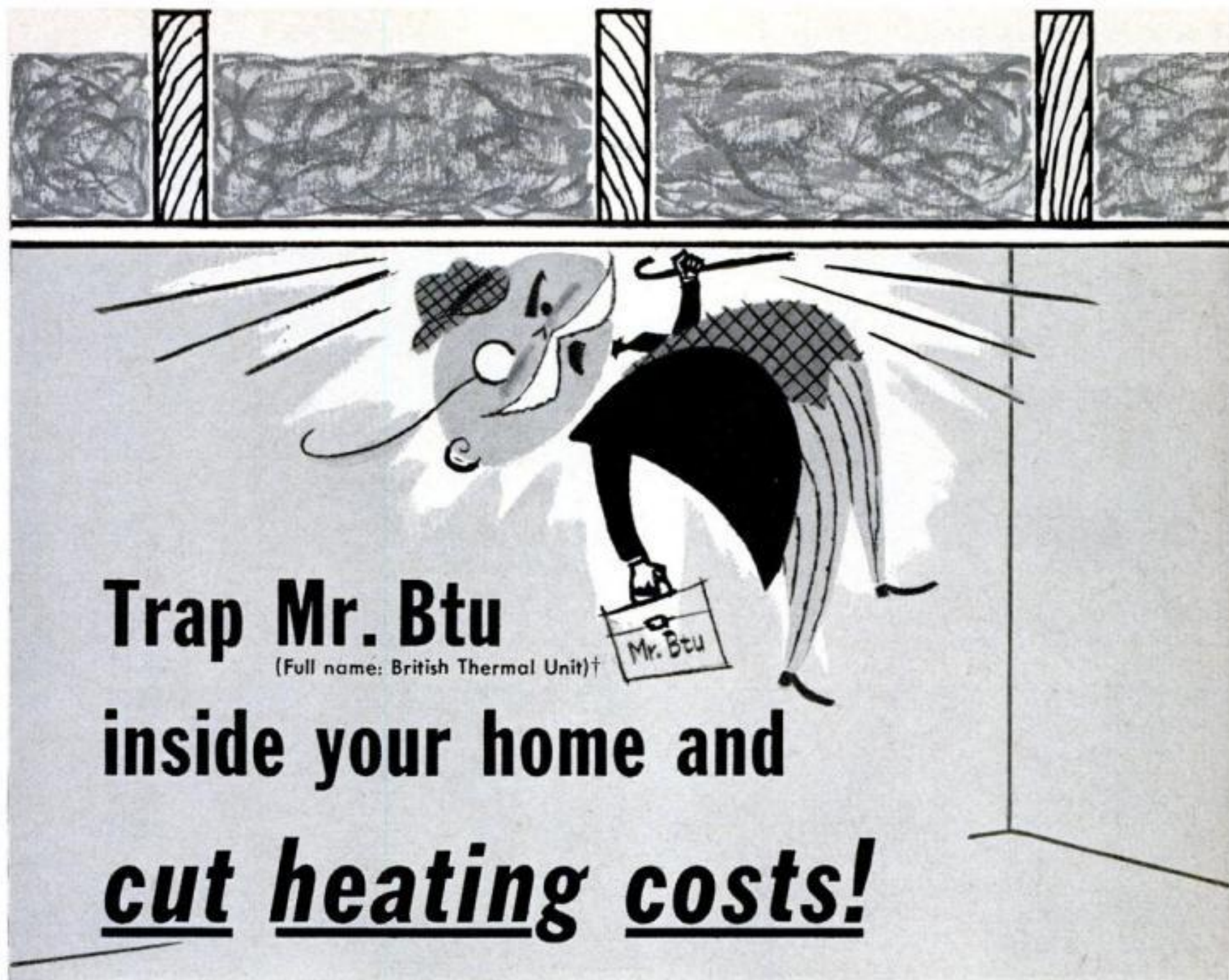
The *right* enclosure will:

- Extend the bass range of your speaker.
- Reduce distortion in the bass notes.
- Preserve clarity of tones in the middle range.
- Add no spurious sounds to the reproduction.

The *wrong* enclosure may:

- Cause the loss of bass.
- Create distortion in the middle and low bass.
- Muddy the sounds in the middle register.
- Generate spurious tones that have no relation to the music being reproduced.

The basic job of a speaker enclosure (or baffle) is to separate the sound coming from the front of the speaker diaphragm from that coming from the back. If these two sound waves representing the same signal are allowed to get together, they cancel each other. This is why any loudspeaker sounds tinny when you play it unmounted. The lower tones are canceled by the back wave creeping around in front. It zigs when the front wave zags;



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[†]A unit of measurement of a quantity of heat
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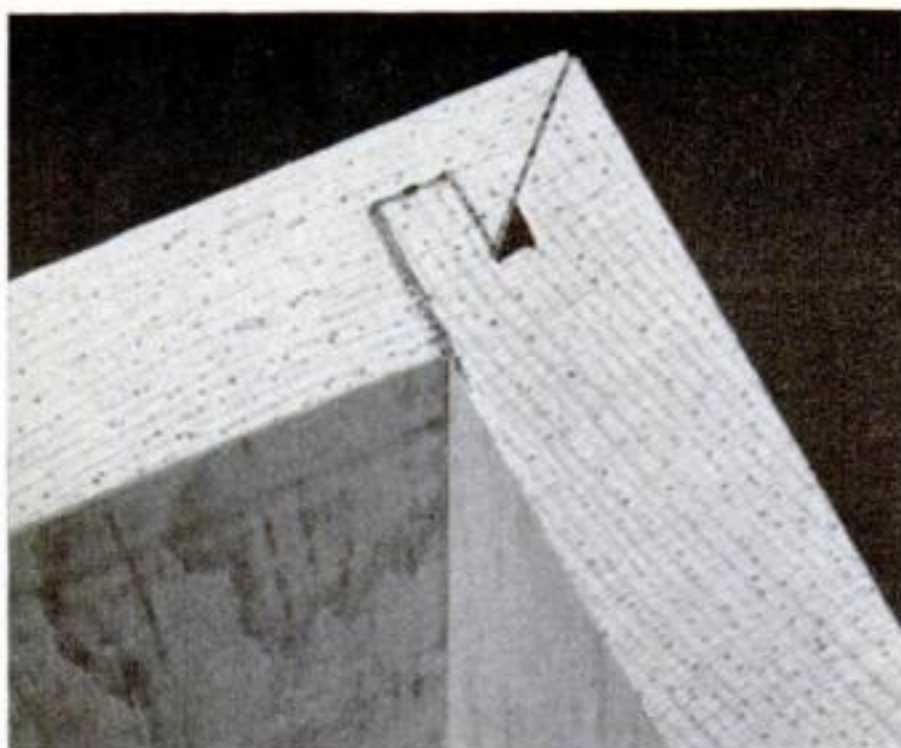
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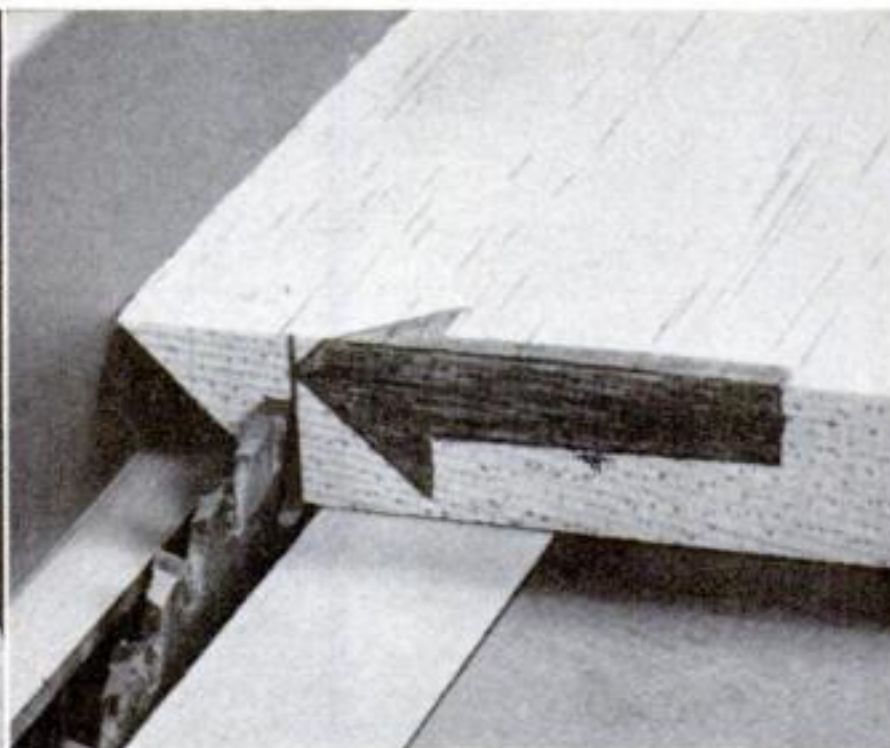
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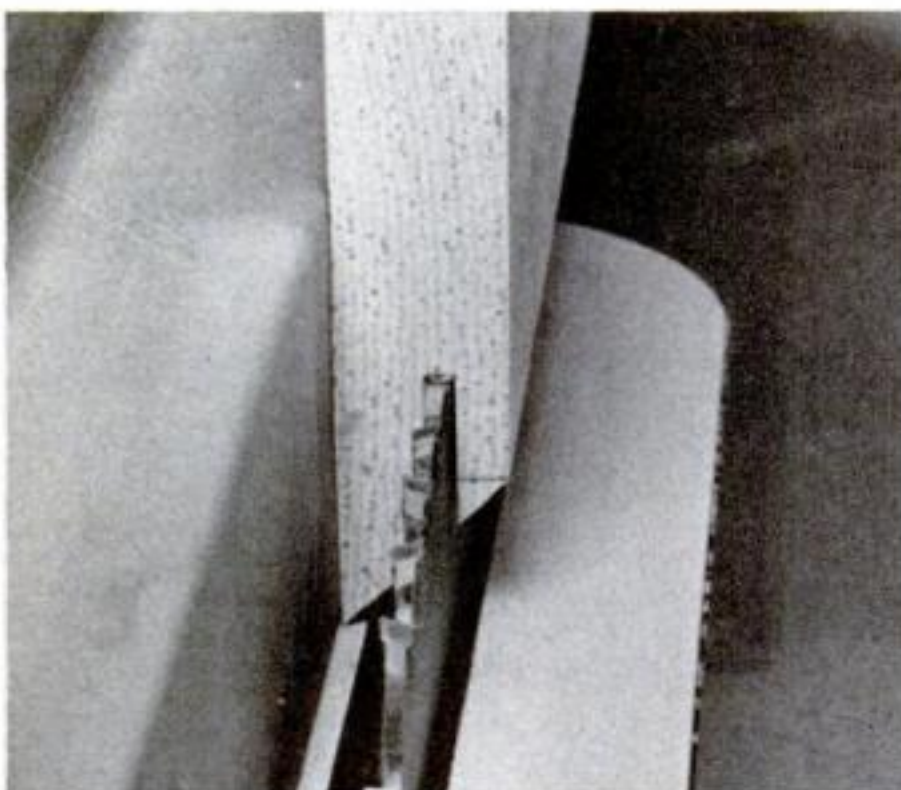
Lock-miter is also a favorite for top-quality enclosures



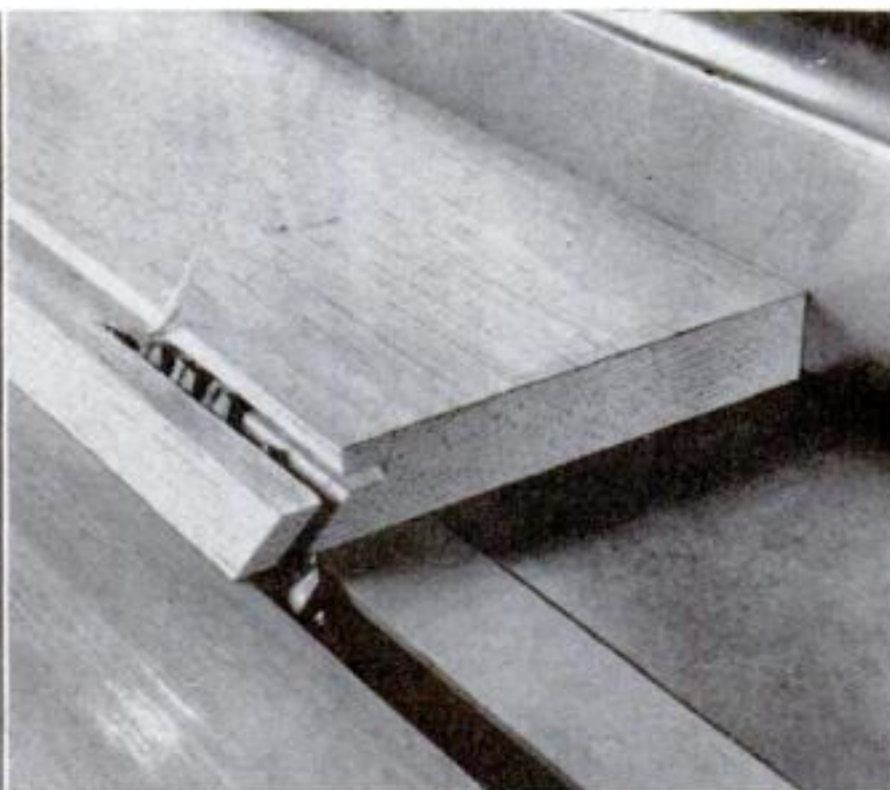
LOCK-MITER, shown here in wood for simplicity, is particularly suitable for hardwood plywood. Miter hides edges and interlock gives strength. Assembly is fast, needs no cleats or screws.



MITER EDGES OF PANELS. Set fence to cut $\frac{1}{4}$ " groove at the base of the miter on one. Use dado or make several passes with saw blade. Set blade height to half the panel thickness.



ON MATING PANEL, make a saw cut to leave a tongue $\frac{1}{4}$ " thick at miter base. Length of the tongue when squared off with base of miter should equal depth of groove in the first panel.



FINAL STEP is to dress second panel so it will fit snugly into the first piece. It's a good idea to practice the cuts on scraps to learn how much to allow for this final trimming.

result: no sound at bass frequencies. The high frequencies aren't quite so sneaky—the speaker diaphragm itself is large enough to keep the front and back apart. So, without a baffle, all you hear is the higher tones.

What to do? A large panel with the speaker mounted in the middle is one answer. If it's big enough and solid enough, you have an effective partition between front and back. The speaker mounted in a hole in one wall of a room is an example. But this arrangement is often impractical and it accomplishes only one job of a speaker enclosure.

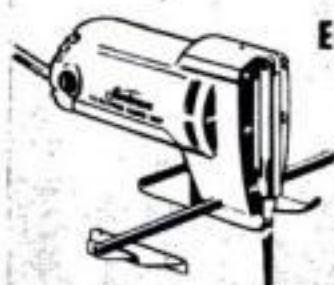
Open-back baffle. Fold back the sides, top and bottom of the flat panel to make an open-back cabinet and you get a baffle of more manageable size. It gives more path length between front and back than a flat panel of equal face dimensions, but still not enough, in practical sizes, for the very low notes. Another drawback: At certain frequencies it will hoot like a holler in a rain barrel. Many radio and TV consoles still use this arrangement.

Infinite baffle. Close the back of the cabinet with a solid panel, make the box airtight, no opening except the hole where the speaker is mounted, and you have

a model for every use...
all with
**Quality, Performance,
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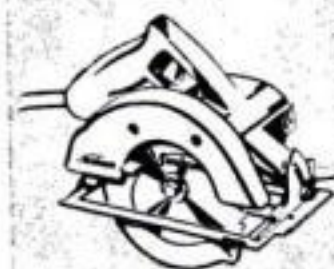


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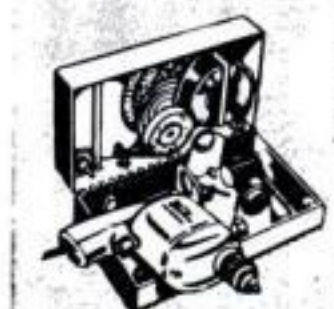
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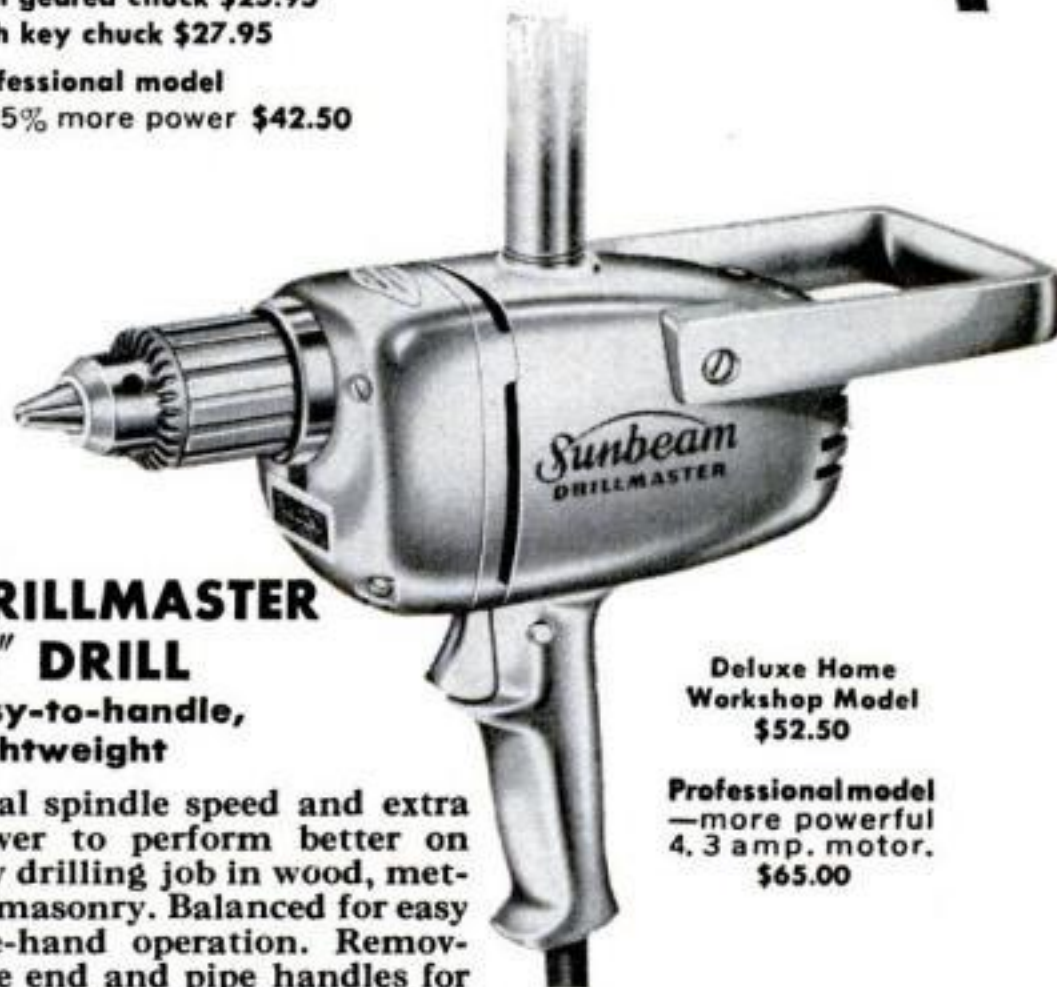
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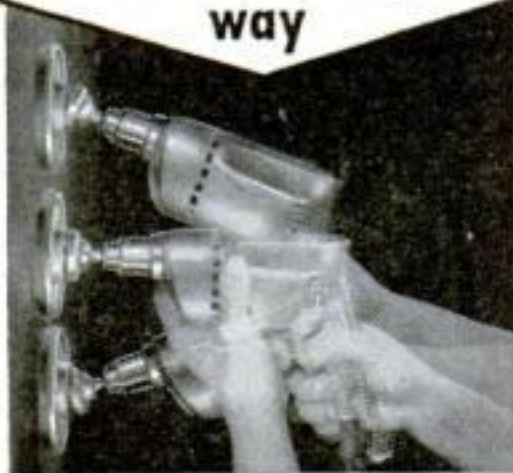
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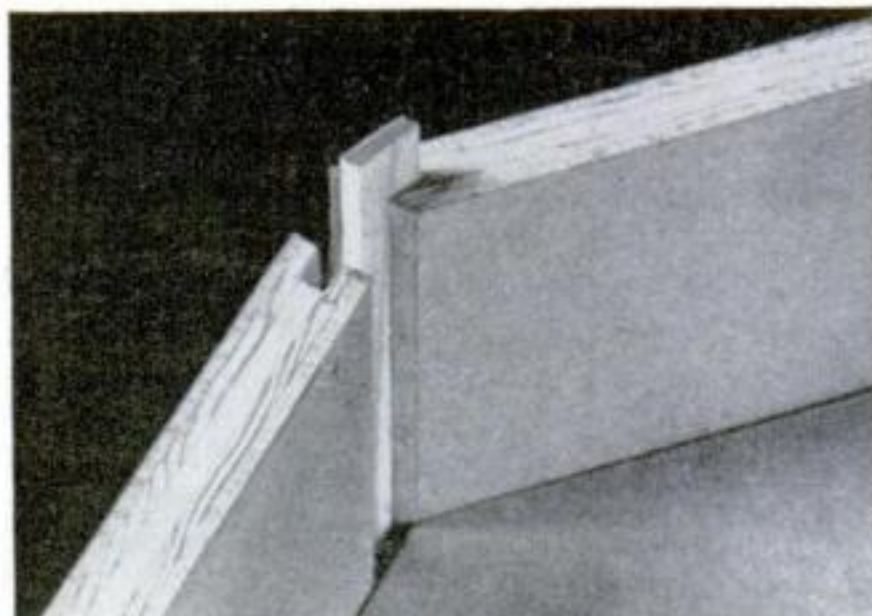


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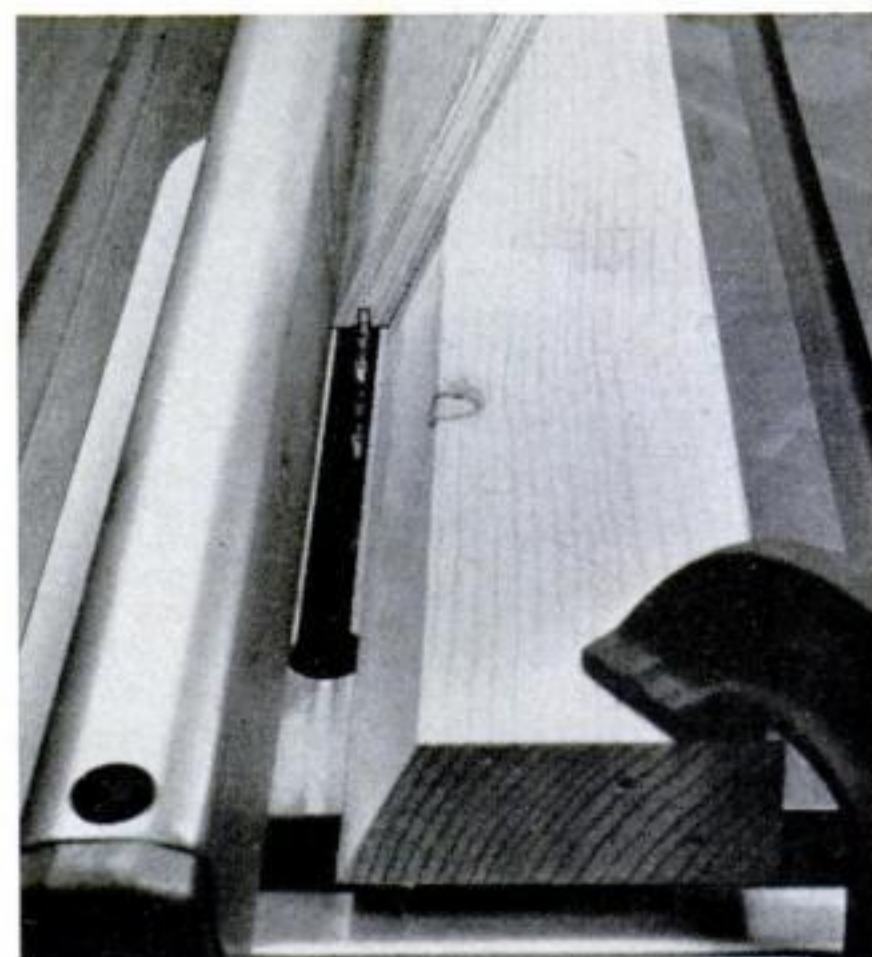
Spline joints solve odd-angle problems in corner enclosures



DESIGNS MAY CALL FOR ODD ANGLES. To find proper angle to cut mating edges, subtract half the included angle from 90 degrees. The result is the saw-blade tilt for making cuts.



SPLINE GROOVES in 45-degree cuts are made by leaving the blade at 45. Adjust height for groove depth, use fence for exact match. Locate groove closer to miter base for strength.



FOR SPLINE GROOVES in odd angle cuts, use a setup like that shown above. The angle on guide strip is the same as the cut. Set the blade height for desired depth of groove.

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trapped the back wave. It can't get out to interfere with the sound coming out the front of the speaker. In hi-fi circles this is called an "infinite baffle," though the term isn't quite accurate. It can give good results when used with a speaker designed for it. It must be fairly large (at least 10 cu. ft. for best results) and it is comparatively inefficient—it needs more power from the amplifier to produce a given loudness than some other types of enclosures.

Bass-reflex. The size of the enclosure can be reduced and the very low bass tones can be produced more efficiently if a second opening is made in the closed box. The size of this opening (called a "vent" or "port") and the volume of air enclosed in the box, must be carefully adjusted to match the characteristics of the particular speaker. This is the bass reflex. When properly designed, it uses the back wave to reinforce the front wave at low frequencies. It does this by shifting the "phase" (it's sometimes called a phase-inverter enclosure) of the back wave so that both front and back sound waves zig together. Since both sounds are added together instead of canceling each other, low notes are produced more efficiently. Both sides of the speaker diaphragm are making useful sound instead of half of it being smothered in the closed box.

Horn enclosures. Theoretically, the ideal device for helping the speaker produce a full range of sound is a horn. The idea is that of a megaphone. The perfect horn would yield the best efficiency, the least distortion, and give the most natural-sounding reproduction. But the perfect horn is not easy to live with. For one thing the mouth would have to be about 14 feet in diameter to give ideal performance down to 50 cycles. Various schemes of folding the horn path and using the corner of the room to extend the horn are used to domesticate it, but they all represent serious compromises. In spite of this, some of the best commercial horn enclosures give truly impressive results. However, unless you can afford the money and the space for a top-quality horn, you are likely to be better off with another kind of enclosure.

Your best choice. Most experts, including the majority of the loudspeaker manufacturers, agree that the most satis-

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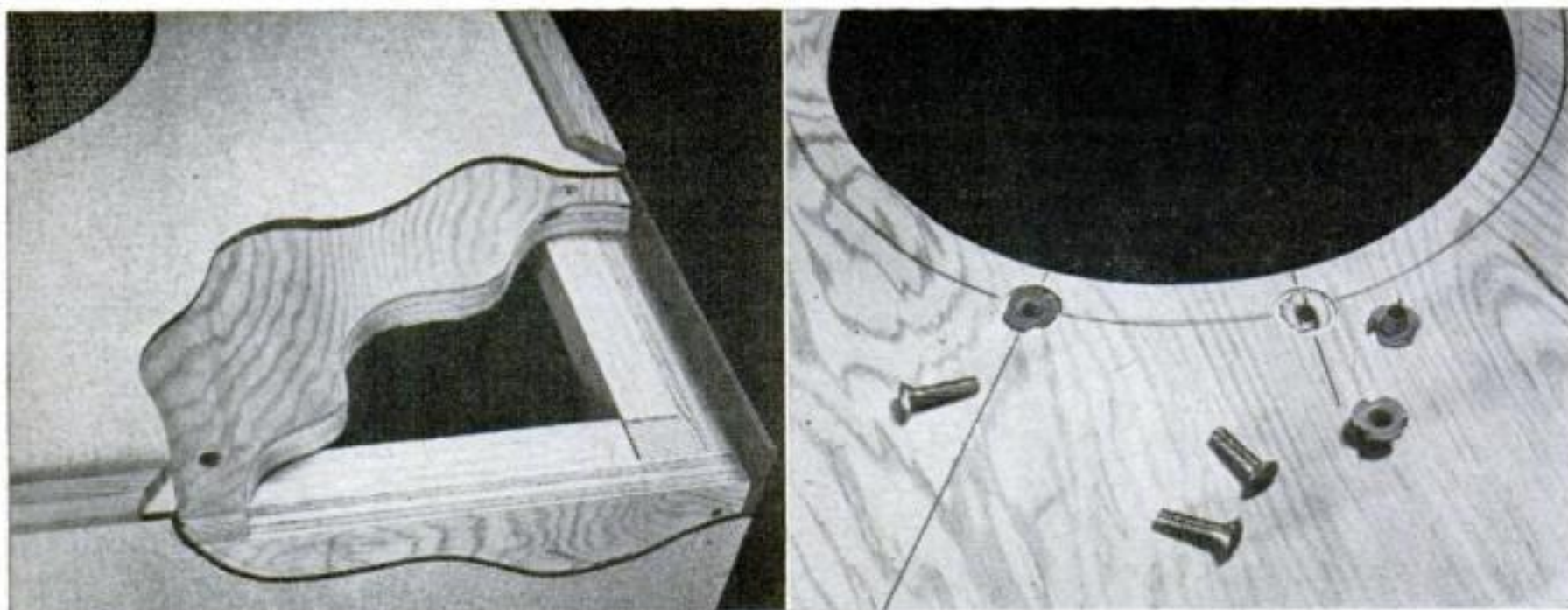
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Enclosure construction can be simple, still look attractive



BUILT WITH ONLY A HANDSAW, screwdriver and glue, an enclosure can be completely satisfactory, as the cutaway shows. Hardboard attached with contact cement makes attractive finish.

T NUTS ARE BEST for mounting the speaker. Counterbore slightly so nuts will be flush with surface. Tighten screws alternately and equally so the speaker frame won't be warped.

factory enclosure for the average home is the bass-reflex. It gives you the best performance for your money if you're buying—and it's one of the easiest to make if you build your own. (Exceptions to this rule are a few speakers that are specially

designed to work in an infinite baffle.)

There are many variations of the bass reflex. Some may be hard to recognize as such. Sometimes the port is made up of many small holes instead of a single opening (distributed port); the port may

Want Plans for Good Speaker Enclosures? Here's Where to Write

THE following speaker manufacturers offer free descriptive and technical literature on enclosures you can

build. In several cases, complete working drawings and manuals are available at nominal cost.

- James B. Lansing Sound, Inc.
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Detailed drawings of many designs at \$3.00 per set. Send for free description.
- Electro-Voice, Inc.
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- Altec Lansing Corp.
1515 S. Manchester Ave.
Anaheim, Cal.
Free pamphlet with plans for bass-reflex enclosures.
- University Loudspeakers, Inc.
80 S. Kensico Ave.
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Free specifications on various enclosures.

- Jensen Manufacturing Co.
6601 S. Laramie Ave.
Chicago 38.
Manual (50¢) includes plans for many enclosure designs.
- Quam-Nichols Co.
Marquette Rd. & Prairie Ave.
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Specifications for bass-reflex enclosures. Ask for catalogue 69-8.
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The articles will help you to get more out of your present equipment, make you a wiser shopper for ready-made units, or enable you to assemble a better system for your money from individual components.

News about new products fresh from the development labs will help you avoid spending your money on equipment destined to become obsolete, or buying new products that have been rushed on the market before all the bugs are worked out by the manufacturer.

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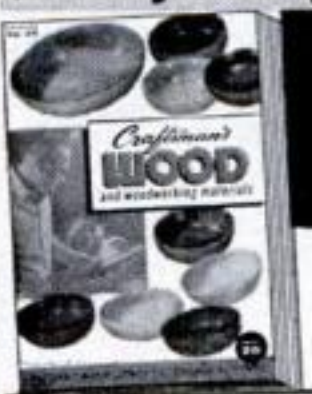
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be a long slot exhausting behind the cabinet into the corner of the room, or a hole in the bottom may feed into a vestigial horn formed by the cabinet pedestal (horn-loaded port); the opening may be covered with a partially sound-absorbent material (resistance-loaded port).

About construction. Aside from acoustic design, there are mechanical construction features that are absolute musts for any good speaker enclosure. Look for these if you buy, or plan to incorporate them in any unit you build:

- Panels must be rigid. Minimum material is $\frac{3}{4}$ " plywood—the heavier the better. Large panel areas should be braced with heavy cleats on edge, glued and screwed in place. No part of the cabinet should become a sounding board for the pressure waves bottled up inside.

- All joints must be solid and airtight. Butt joints should be glued and reinforced with continuous cleats glued and screwed to each member. Splined, lock-mitered or dado joints should fit tight and be glued solid. The removable panel should have a gasket and be attached with screws

spaced no more than 4" apart around the entire periphery.

- Adequate sound-absorbing material should cover at least one of every pair of parallel surfaces inside the enclosure to soak up sound waves that might bounce back and forth between them. A curtain of absorbent material stretched diagonally across the inside space is often more effective in breaking up these standing waves.

Plans to build your own. Acoustic design of a successful enclosure is best left to the experts unless you are willing to spend a lot of time experimenting and acquiring the know-how. Fortunately you don't have to become an expert to build a good one. Loudspeaker manufacturers are eager for you to use their products in the best possible enclosure, so most of them offer detailed plans for constructing performance-proven units.

All you have to do is write directly to the maker of the speaker of your choice. The cost, if any, is nominal. And you can be sure the enclosure you make will match your speaker exactly. **END**

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The Facts About Stereo Hi-Fi:

[Continued from page 218]

necessarily dampened by the need to keep an eye on costs, here are some thoughts:

- Stereo records and pickups are in the early stages of development. While the present stereo system has been adopted by the industry as the standard, there are other systems under development that show promise. Any of these that prove to be significantly better could replace the present system.

- Any switch to another recording system would likely require changing only the pickup cartridge, if that. But the records you buy now might suddenly become obsolete.

- Tape stereo in its present form has proven quite satisfactory in the five or six years it has been used. The big drawback has been cost. The new slow-speed, four-track stereo tape cartridges will bring recorded tape costs down—but you won't be able to play them on present machines.

- Stereocasts by FM-AM radio stations are increasing. This is the cheapest way to find out how you like stereo in your own home. The quality of your stereo will be highly variable, but if you have both an FM and an AM radio in the house, it costs nothing to try it.

- Neither tape stereo nor disc stereo is likely to completely supplant the other. Each has its own particular virtues. Records will probably continue to be the preferred medium for the mass market in home music, while the hi-fi fans will go in more and more for tape.

- Some persons hear much more acutely with one ear than the other. If there is a big difference in sensitivity between your two ears, you may hear little or no difference between stereo and single-channel hi-fi reproduction. In this case, save your money and put it into better single-channel equipment.

Is it just a passing fad? Most experts think that stereo is here to stay and that it will grow tremendously in the next few years. But many of them do not agree with predictions that stereo will make monaural sound obsolete. While stereo is impressive for concentrated listening and will win many true music lovers, they say, there will always be a big market for the less demanding types of home listening.

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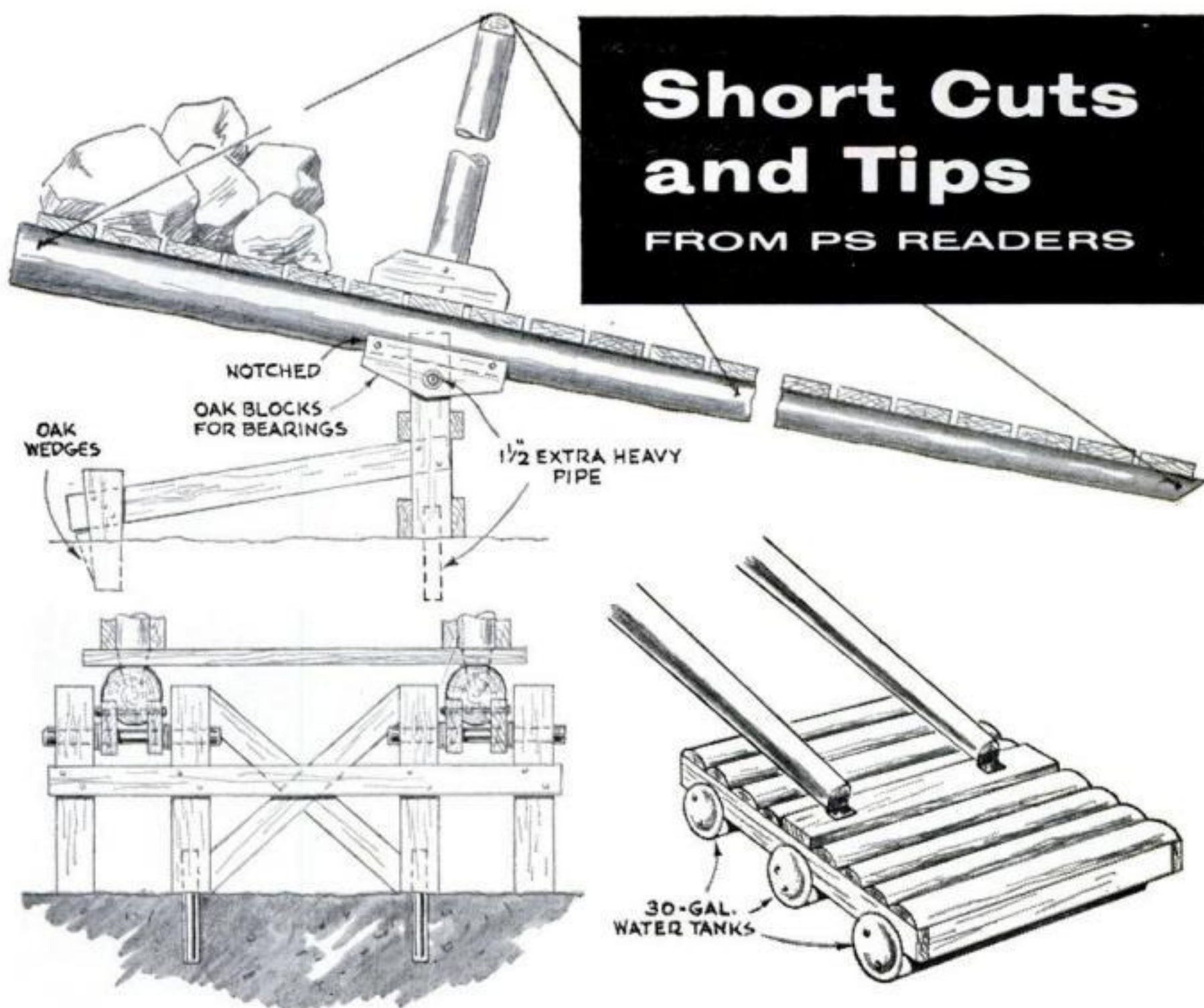
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Seesaw Floating Pier Lifts Up for Winter Storage

At our summer place at Boothbay Harbor, Me., I built a floating dock for boats and swimmers. It is designed like a bascule bridge, its floating end rising and falling with the tide, which varies as much as 12'. For winter or approaching storms, we add counterweights to its shore end and lift the float completely above the water and out of harm's way.

I used two 52' spruce stringers for the main structure and decked them with sawmill slabs. Some shorter timbers,

braced with guy wire, make a supporting tower. The float consists of a frame of scrap lumber decked with slabs and resting on three hot-water tanks. It is hinged to the stringers from a cross block.

For the fulcrum I chose a spot on a ledge safely above high tide. It was made from heavy scrap lumber and hinged to the stringers with oak bearing blocks and two lengths of 1 1/2" extra-heavy pipe. Rocks piled on the end serve as counterweights.—Robert S. Hackett, Scarsdale, N.Y.



Short Cuts and Tips

Sturdy Workbench Made from Old Desk

AN old-fashioned flat-top desk, which I picked up for a few dollars at a second-hand-furniture store, forms the base for this workbench. I removed the old top and replaced it with two-by-fours glued and cleated together, providing sufficient overhang for mounting a woodworking vise. I then planed the new top smooth and covered it with a sheet of hardboard which can be replaced when badly scarred. A shelf between drawer sections gives extra storage.—*C. A. Phillips, Corning, N. Y.*



▶▶▶ WHEN hanging wallpaper, instead of lapping it around the corner of the room, cut your strip even with the corner. Then butt the next piece against it. The paper won't crack at the corners as the house shrinks and swells with changing weather.—*Harold R. Terpeny, Marion, Mass.*

▶▶▶ "THE most unkindest cut"—is the one that ruins your last piece of wood. When marking a length longer than your rule, it is good practice to identify the six-foot pencil mark with a distinct "6". Then there is no chance of making a fatal slip.—*Nils E. Mockler, Putnam Valley, N. Y.*



Boiling Your Oilstone Clean

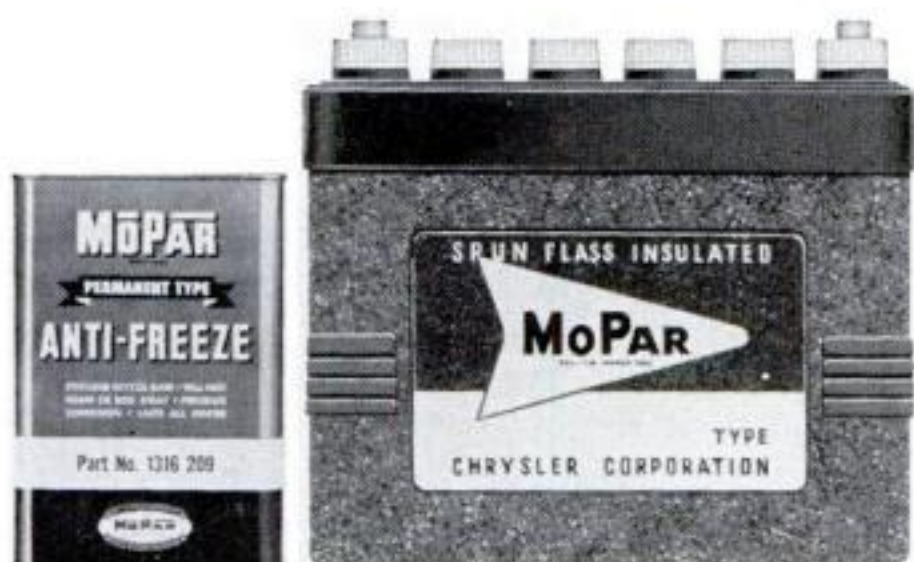
BITS of steel and hardened oil put a glaze on an oilstone that reduces its sharpening ability. I've found that boiling the stone occasionally in clean water will remove this glaze and avoid a resurfacing job.—*Frank A. Javor, Newark, N. J.*



How to Patch a Downspout

TO REPAIR a rusted-out downspout without removing it, you can simply wrap the bad spots with strips of fiberglass. Apply resin both before and after patching. This method is especially effective at joints.—*V. Lee Oertle, Azusa, Cal.*

WHAT DO YOU LOOK FOR IN BATTERIES AND ANTI-FREEZE?



If you follow the example of the men at Chrysler Engineering, you'll have a lot of things to look for in specific detail. In MoPar batteries, for example, the extra attention to detail has led to these important developments:

Positive grid plates are sealed by a silver cobalt coating, increasing the resistance to overcharging (the cause of most battery failures) by 300%, and reducing the corrosion of grid metals. MoPar's spun-glass insulation insures a constant supply of electrolyte at the positive plates by its constant wicking action—further protecting battery life.

You can get both dry and wet charge MoPar batteries. Why not ask for a free battery check at your local Plymouth, Dodge, DeSoto, Chrysler or Imperial dealer—and, at the same time, ask about the liberal allowance for your old battery.

Equally rigid requirements apply to MoPar anti-freeze. If you list what a good anti-freeze

should do, you'll find that it should do a lot more than just give highest quality cooling system protection at the lowest possible price.

It should also:

1. Protect copper, brass, aluminum, solder, steel and cast iron from corrosion.
2. Resist turning to acid or becoming gummy or rancid.
3. Effectively inhibit rust and water scale.
4. Remain uniform in storage or use.
5. Contain no injurious chemicals such as salt, glucose or petroleum.
6. Mix instantly with hardest water—and with other types of anti-freeze.
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To set up such requirements for MoPar anti-freeze, Chrysler engineers demand a product that surpasses both U.S. Bureau of Standards specifications and S.A.E. standards. When you get MoPar anti-freeze—either permanent or methanol type—you get guaranteed, Chrysler-engineered performance.

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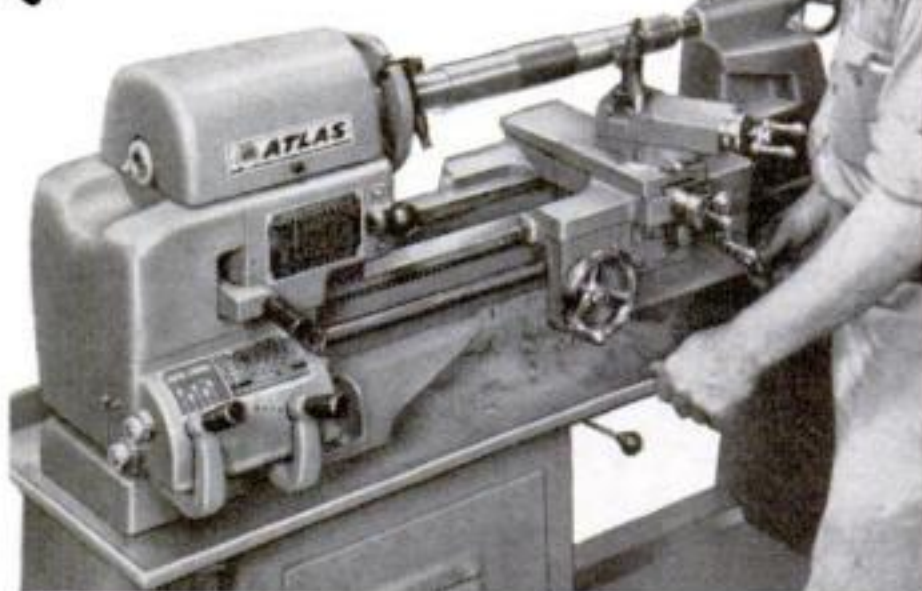


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No-Hands Landing System

[Continued from page 114]

A lot has happened since that day in 1951 when the contract was let. It culminated in a test in August, 1957, when the automatic landing system was lugged aboard the carrier Antietam.

Thirty-six times a Douglas F3D jet night fighter, carrying a corner reflector, took off and circled. Thirty-six times it landed with the pilot sitting there, scared but game, doing nothing. On 20 landings the tail hook caught the target wire of the six arresting wires on the deck. Fifteen times it caught one of the adjacent wires. Once it caught a wire farther down the deck.

The point of touchdown never varied more than 22 line-of-flight feet from the point designated by the analog computer, and never more than 10 feet laterally from the dead-center line of the runway, despite the carrier deck's constant rock-and-roll.

Checks and doublechecks. No complex system like this is any good unless it will "fail safe"—provide an out if something goes wrong. The Bell system arranges for this.

An airplane's pilot can watch his descent on the cross-hairs of his cockpit ILS. If they don't center, he can take over the controls. He's in constant radio communication with monitors on the ground. The monitors sit at a console full of dials that constantly doublecheck the operation of radar, computer and airplane. A red light can be made to flash on the pilot's instrument panel if a computer misbehaves—if, say, it should blow a tube.

The engineers who conceived the system and nursed it to maturity are realists. They know that pilots as a breed look biliously on anything that substitutes for manual airplane control during landings, just as they also abhorred artificial horizons for instrument flying only a quarter century ago.

But if pilots can be made to trust the system to break-outs under ceilings of even 25 feet, a long stride will have been taken toward all-weather operation. Bell engineers are confident that eventually airliner landings under zero-zero weather conditions will be a commonplace, the civil-aviation rules of the federal government permitting.—*Devon Francis and Philip Gustafson.*



THIS is the time of year when caution and calm judgment pay special dividends in safety. Fast-changing weather conditions can turn roads you know like the palm of your hand into dangerous skid traps.

So keep your eyes peeled for misty-looking pavement, wet leaves, mud slicks and, of course, ice and sleet. They're all dangerous. But you can reduce these hazards by slowing

down cautiously the moment you spot them.

Yet, suppose your car's rear wheels "break loose" anyway . . . here's what to do to regain control: First . . . don't hit the brake! Instead maintain light gas pedal pressure and steer front wheels *in the same direction* as the skid. Once you're tracking again, lift your foot off the gas and pump brakes lightly to slow down.

Cut down engine friction

Ordinary motor oils stiffen up in a cold engine—thin out in a hot one. Either way, they can't give full protection against wear. But Havoline Special 10W-30 Motor Oil stays free flowing in dead of winter to give you instant lubrication when you start. Its tough film won't break down at highest engine temperatures. And Havoline Special 10W-30 cleans as it lubricates! Result: you get *full protection* against wear, dirt and deposits. Your engine stays young, powerful, smooth running. Change to Havoline Special 10W-30 Motor Oil at your Texaco Dealer.



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World's First Atomic Alarm

[Continued from page 95]

phenomenon would be sure to take place.

Spontaneously, the graphite would suddenly release its stored-up energy, in a flood of heat. Reactor men call this a "Wigner release," after the U.S. physicist, Eugene Wigner, who predicted the phenomenon.

Laymen who never heard of it are in good company. It was almost equally unknown to the designers of the Windscale piles, when construction began in 1947.

When Windscale's operators and others later became aware of it, they also learned how to forestall this unexpected, and possibly dangerous, outpouring of heat. The graphite's self-heating could be triggered prematurely, they found, simply by running the pile hotter than usual. Cautiously done at intervals of months or years, this would harmlessly dissipate the stored-up energy, before it built up excessively. Eight such "controlled Wigner releases" had been carried out successfully in Pile No. 1.

On Monday evening, October 7, the time had come for another. Following standard procedure, the pile was run for several hours with air-cooling shut off, to raise its temperature. Early in the morning of Tuesday the 8th, the physicist in charge judged that the Wigner release should have been triggered, and shut down the pile.

But the temperature indicators in the pile's control room failed to show the expected self-heating of the graphite. Was a second triggering necessary, as had sometimes happened before? The physicist decided that it was—and the crew restarted the pile, running it from Tuesday forenoon to late afternoon.

By hindsight, that was the fatal mistake. For the Wigner release had actually begun already. (Too few and poorly placed, the early pile's heat-sensing probes proved unreliable to detect it.)

Pouring in more heat, as restarting the reactor had done, was like throwing gasoline on a roaring fire.

All that day and the next, Wednesday the 9th, Pile No. 1 grew hotter and hotter. Its fans, turned on at intervals Wednesday night, checked the rise only temporarily. Bad news came shortly after noon the next day, Thursday the 10th.

Radioactivity was escaping from the

top of the air-exhaust stack, through filters supposed to stop it, and was settling on the plant's other buildings.

Evidently one or more of the pile's fuel cartridges, of uranium metal sealed in aluminum cans, had burst—and must be found and removed at once, to stop the leak of radioactive fission products.

Pile No. 1 had a movable "scanning gear" to sniff air from any of the pile's 20,000 fuel channels, and check it for escaping radioactivity. At this critical moment the remote-operated sampler refused to budge. Heat had jammed it.

Ghostlike in protective white coveralls, the reactor crew went in to find the leak firsthand. At 4:30 Thursday afternoon they opened a plug, and peered into the fuel channels at the pile's hottest spot.

A red-hot glow met their startled eyes. The uranium was on fire.

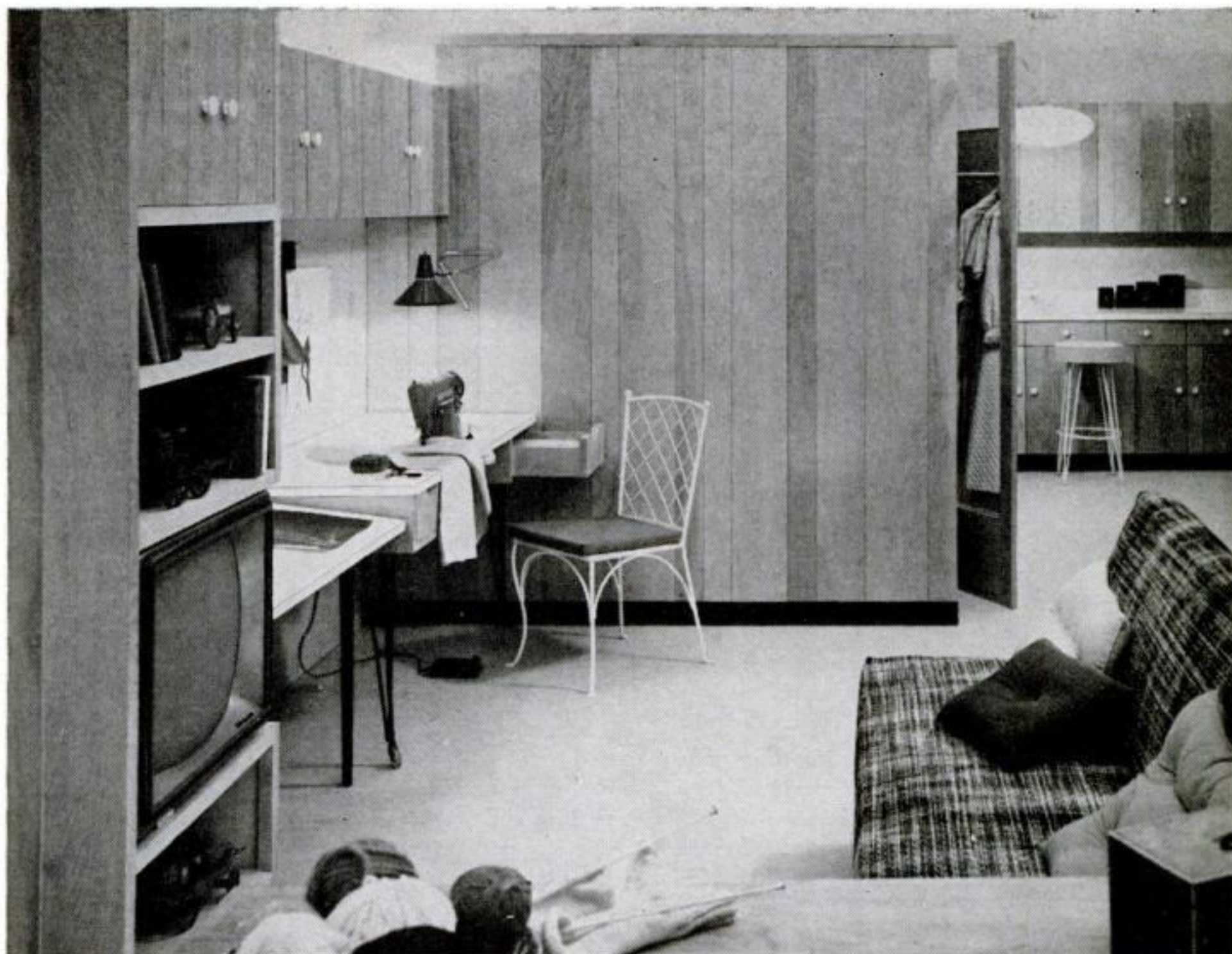
Fuel cans must have been distorted, and some of their ends pushed off, by the excessive heat from the pile's ill-advised restarting on Tuesday. Exposed to the air and heat, the combustible uranium probably had been smoldering for days. Now it was fully afire in 150 fuel channels, burning in its eerie flameless way—and loosing its dangerous fission products.

Vainly the crew tried to push the burning and heat-twisted cartridges out of the pile. They were wedged in.

Windscale mobilized for an emergency. Available to fire fighters were 20 tons of carbon dioxide gas, kept next door at the Calder Hall A-power station to cool its pile. If that failed, water would be a last resort. Water ruins a graphite pile—it's soaked up by the graphite, which is almost impossible to dry out. Worse, when water hit the red-hot uranium, steam might blow the pile apart and shower the region with fallout. But if the fire continued, the countryside would get the fallout anyway.

So things were when the phone calls warned the Prime Minister and the Chief Constable. During Thursday night the carbon dioxide was pumped into the burning pile. It didn't work.

As Friday dawned, firemen laid hose lines to pour water into the pile. The morning shift of Windscale's workers got under cover; construction men working at Calder Hall were sent home. At 8:55 a.m.



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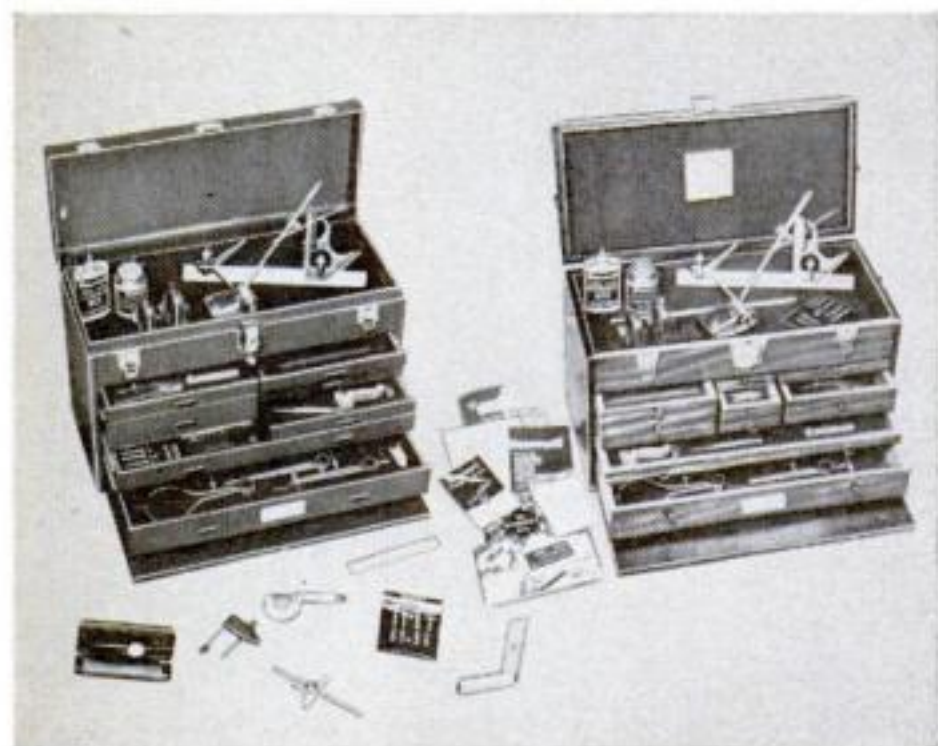
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World's First Atomic Alarm

the firemen turned on the water. It hit the hot channels with a hiss of steam. There was no explosion.

Hour after hour the water flowed in, at first without seeming effect. Then the pile's temperature began slowly falling. The fire was under control.

Two Atomic Energy Authority vans had been rumbling along outlying roads all through the night, with crews taking readings of the body-penetrating gamma radiation from the fallout; and continued to, on Friday. Other A-men measured radioactivity that could be inhaled, from airborne fallout particles. Some readings showed 150 times the safe level for lifetime exposure. But none reached the danger point for short-lived radioactivity, such as this.

Still to be gauged was another possible hazard, of internal exposure from radioactivity in food and drink. But there was no immediate radioactive peril and, with the fire checked, the crisis was past. Evacuation would be unnecessary.

By Saturday afternoon the pile was cold and the fire out. The 30¼-hour flow of water was turned off.

Discovery of radioiodine in the region's milk came as an unwelcome and surprising anticlimax. Stack filters should have caught the ordinarily solid iodine 131. Evidently the fire's heat had vaporized it—and the purple iodine vapor, probably too diluted with air for its telltale hue to be visible, then escaped unhindered.

When that contamination in turn had died down, the damage, the blame, and the lessons of Windscale's accident could be assessed.

III

Investigators pinned the blame on the pile's inadequate instrumentation—plus "faults of judgment by the operating staff," which in turn were laid to lack of detailed-enough instructions for the special Wigner-release procedure. (Accepting responsibility, the AEA said no individual would be disciplined.) For the staff's courageous and effective actions, once the emergency was realized, the investigators' report had high praise.

Dwellers near Windscale complained bitterly of having been kept in the dark during the crisis. In seeming answer,

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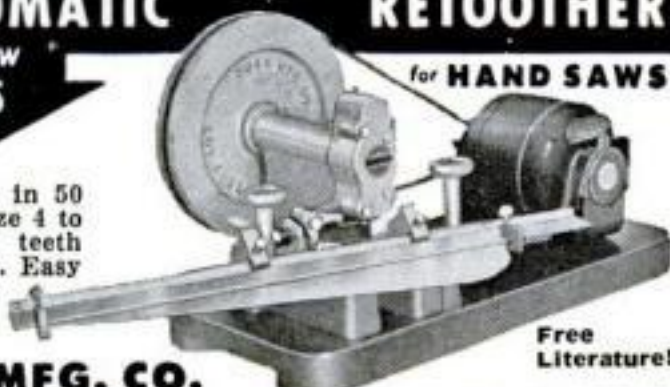
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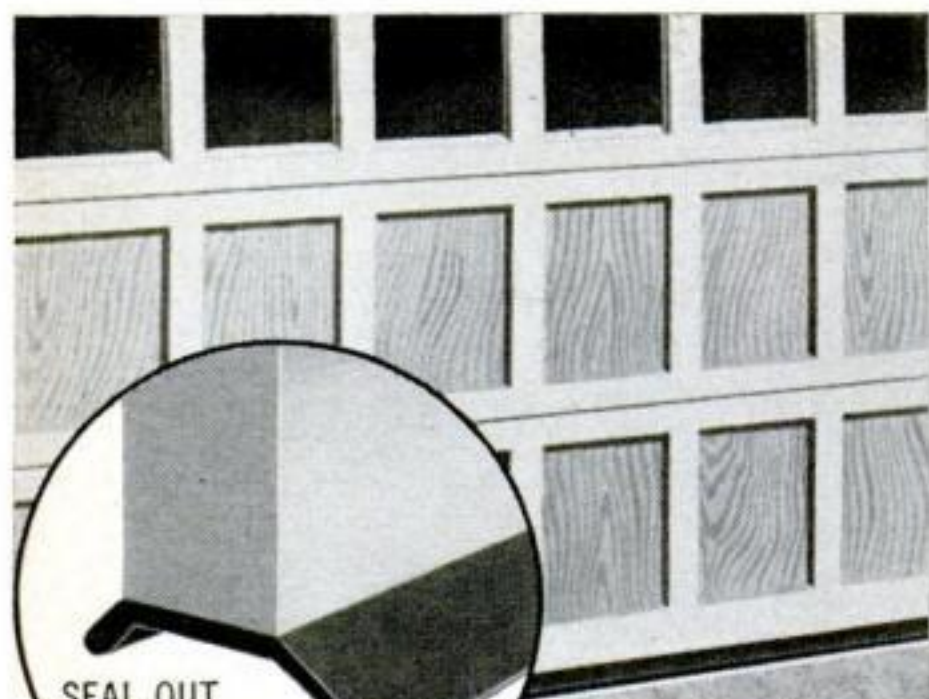
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the AEA promised "closer liaison" between Windscale and "local interests."

For damage done to private property, the AEA promised to pay all legitimate claims. The matter of the spilt milk was easily settled without tears. Not as simple or provable in every case were farmers' claims of other damage. Prospective buyers, they say, look askance at cattle from

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the "radioactive" area—and the value of land there is said to have plummeted.

Windscale's ruined Pile No. 1 will be junked. Its twin, Pile No. 2, has been shut down; experts advise installing improved instrumentation, before re-use.

In applying Windscale's lessons elsewhere, there are limitations to bear in mind. Nowhere else could just the same accident happen. Among really high-powered reactors, Windscale's piles were unique in being cooled by air—whose discharge through a stack, into the open, was the route by which radioactivity escaped. (The nearest thing to them in the U.S., Brookhaven's air-cooled research reactor, is a baby by comparison.)

A uranium fire in plutonium-making reactors like our mighty ones at Hanford, which are water-cooled, couldn't possibly spew radioactivity into the open air.

But such powerful reactors *could* scatter radioactivity to the winds in other imaginable accidents, such as a "run-away" chain reaction from loss of control. (It's because of that possibility that power reactors near our cities are sealed in fallout-trapping domes or tanks.) What would happen if a high-powered reactor's radioactivity got loose has been dreaded—and unknown for lack of any actual case.

So the Windscale accident gives one answer, where there was none before. And its warnings, if fully heeded, may help avert future calamities. **END**

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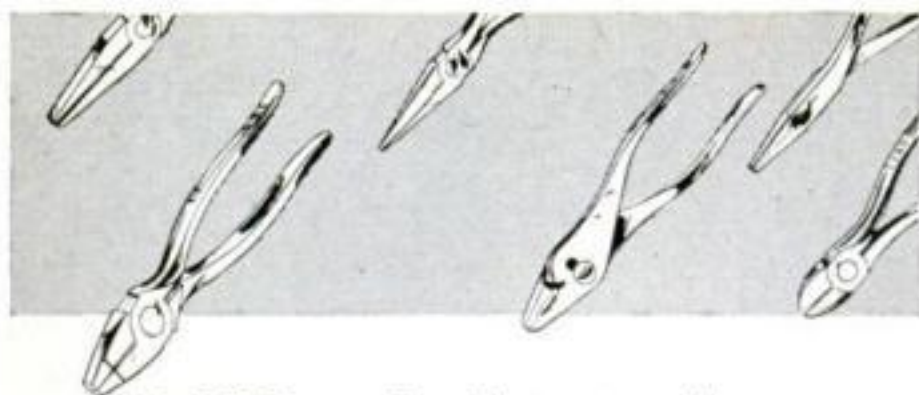
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The '59 Caddy [Continued from page 89]

sorber, the oil could do its work properly.

So the engineers put something compressible—the Freon 12, an inert gas, the same thing used in home refrigerators and car air-conditioners—into a little plastic envelope in the oil reservoir. The gas shrinks as the oil flows in, expands as it flows out.

Cadillac horsepower is up a smidgen. So is the compression ratio—a quarter of a point to 10.5-to-1—and the piston stroke is lengthened a quarter inch to 3.875.

Customarily, the power output of an engine doesn't go up by simple formula with the cubage, due to increased friction. For 1959 Cadillac figures it has a neat jackpot. By a combination of valve size, lift and timing, and the use of a new intake manifold, the engineers have pulled 15 more horsepower—for a total of 325—from an added cubage of only 25 inches on the standard four-barrel carburetor. The power output with three two-barrel pots is up 10 for a total of 345.

The bore remains the same for a reason. The fashionable short-stroke engines of the last decade (often "over-square" like the Cadillac's) trade better mechanical efficiency for less thermal efficiency—there's less friction but less use made of the engine fuel, too. The bigger the bore and the shorter the stroke the less thermal efficiency. The flame has to travel farther across the cylinder head to consume the gas charge and the sheer size of the head makes it radiate more heat. Lost heat is lost energy.

For economy, the Cadillac's standard axle ratio is down from 3.07 to 2.94:1.

There are other changes. The Hydra-Matic transmission, most economical of all the automatic drives, has been simplified by eliminating the rear pump in the control system. It was only used for push starts, and who pushes a Cadillac?

The power steering is improved, a development shared with some other GM cars. The air springing gives a softer ride, cuts the squat on starts and the dive in braking.

The Cadillac people are mildly puzzled by one endearing characteristic of the new car. It has, they say, an astonishing stability in crosswinds.

"Must be," mused a Caddy engineer, "a fringe benefit from those big fins." **END**

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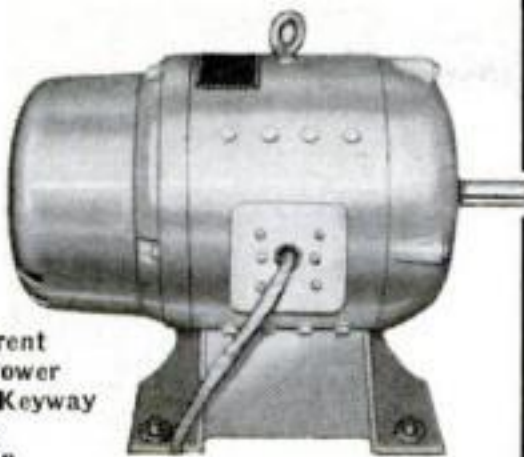
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The '59 Olds

[Continued from page 91]

the country, notably in California, after the production of the 1958 models was begun. This, mainly, was because gasoline refiners didn't boost their octane (anti-ping) ratings as Detroit had anticipated. West Coast gas usually is at the bottom of the scale. The car makers reduced compressions quite simply—by inserting thicker cylinder-head gaskets.

For 1959, Olds has stayed with its 10:1 compression, but, like Cadillac, has increased cubage slightly by lengthening the piston stroke. Piston barrels are proportionately longer. The water-bathed area of the barrels has been upped for more precise engine-heat control. In the interest of gas economy, Olds no longer offers three two-barrel carburetors for its top-line engines. Only a four-barrel is available. Axle ratios are unchanged.

The biggest step Olds engineers have taken toward fuel economy is in separating the two cold-weather functions of the carburetor—choking and fast idle. It's choking that costs gas in the winter. Heretofore, the car would remain on choke for almost two miles during warm up. Now the extra-rich mixture shuts off in three-quarters of a mile. Meantime, fast idle, less wasteful, continues until the engine is at the proper operating temperature.

For 1959, the carburetor choke cam operates twice as fast as the fast-idle cam, opening up the butterflies and reducing the suction on the fuel nozzles. Cadillac shares the development.

There are many other improvements—a brand-new frame, a prop shaft of smaller diameter to reduce the tunnel height in the rear compartment, cooler brakes and easier power steering. The rear leaf springs are mounted forward of their centers to reduce squat at hard takeoff.

Air for the optional air springs is filtered twice to exclude any foreign matter that might affect the valving—once through the carburetor air filter and again through a filter in the air-spring system.

The new Olds operates more quietly, handles better and rides easier despite (or because of, as size conscious GM argues so eloquently) its bulk and weight. The kids who took the picture would have had more on that film than they realized if only they had got away with it. **END**

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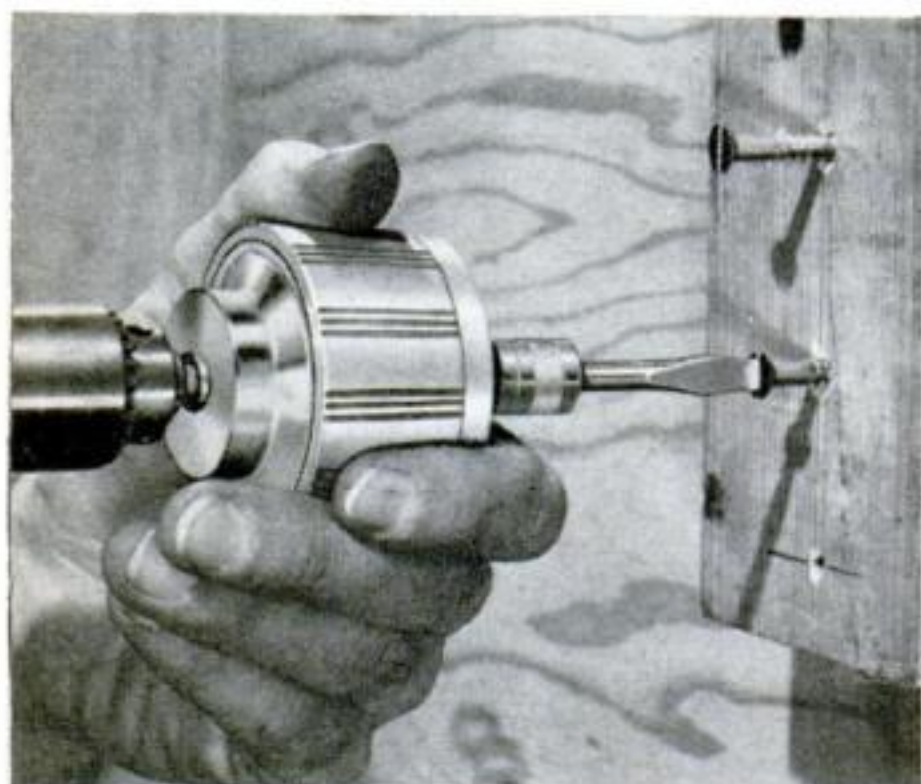
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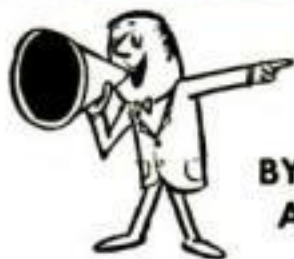
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SUPREME PRODUCTS CORP. CHICAGO 16

How to Put Your Good Ideas on Paper

[Continued from page 122]

ply by .4. The result is the school-grade level at which your written language would be understandable.

Most popular magazines, says Gunning, have a Fog Index of 7 to 9. Even magazines written for intellectuals rarely go beyond 10, which Gunning considers the maximum for clarity. If you measure out at 10 or above, your letters and reports probably aren't being fully understood.

● **Put only one idea in each sentence.** Don't string ideas together with conjunctives—*and*, *but*, *so*. For example: "The machine is getting old so I suggest that the company buy a new one." It reads more easily if you chop it in half with a period: "The machine is getting old. I suggest..."

Force

"Making the reader understand your thought isn't usually enough," says the AMA's Schmidhauser. "I may get a letter from a finance company saying I owe some money. I may understand perfectly. But will I pay—will I take action? That's the final test of the letter."

That's what is meant by force. According to Schmidhauser, virtually everything you write is designed to get some kind of active response from the reader—even though it's only an emotional response, such as liking you. If your letters and reports have no force, they'll get no response.

How do you create force? "First," says Schmidhauser, "decide exactly what response you want to get. Ask yourself: What am I trying to get this guy to do? When you've done this, you've built the backbone of your letter or report."

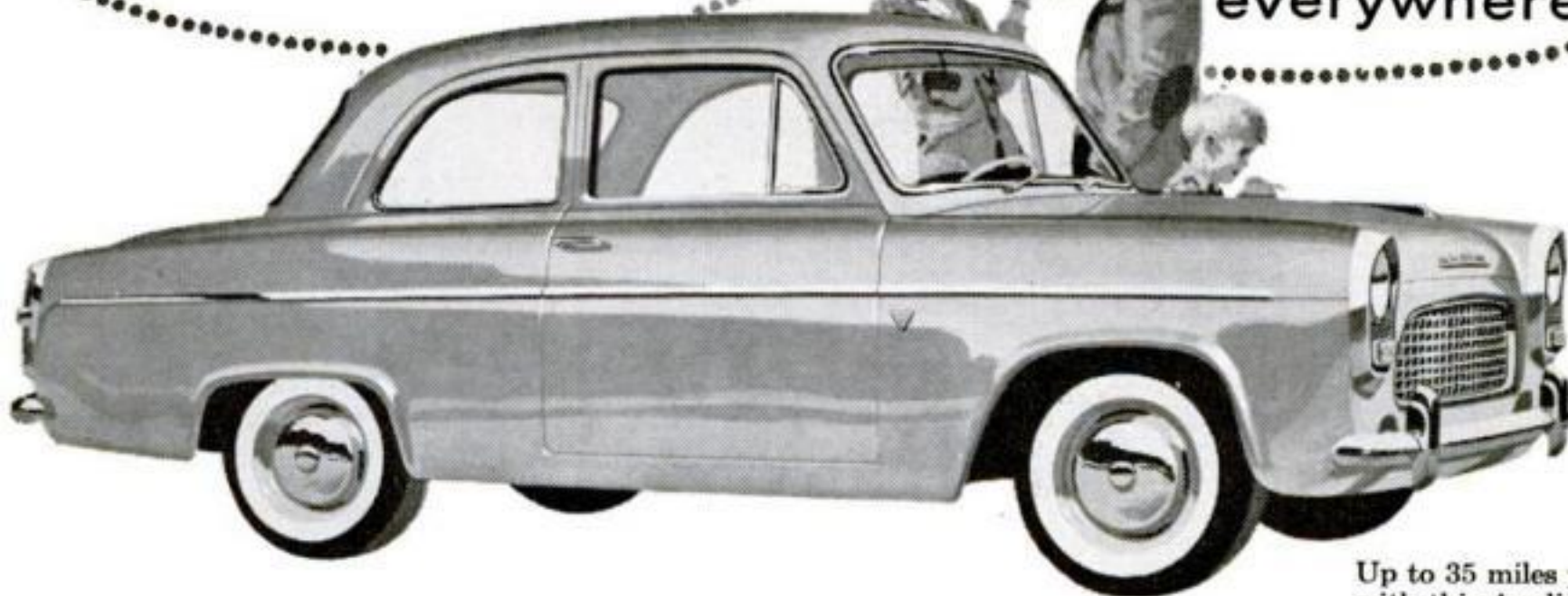
Now, Schmidhauser suggests, sit down and write a rough draft of it—backwards.

If it's a letter, first sign your name—Joe, Joe Smith, Joseph H. Smith. In doing this, you'll establish in your mind the personal relationship between you and the reader. This will set the tone.

Now write the last sentence, or, if it's a report, the conclusion or summary. "Ask yourself," says Schmidhauser, "how you want this man to feel when he finishes. Eager to get going on your project? Anxious to meet you? Interested to hear more? Get it into your concluding words." Now comes the body of the message, and

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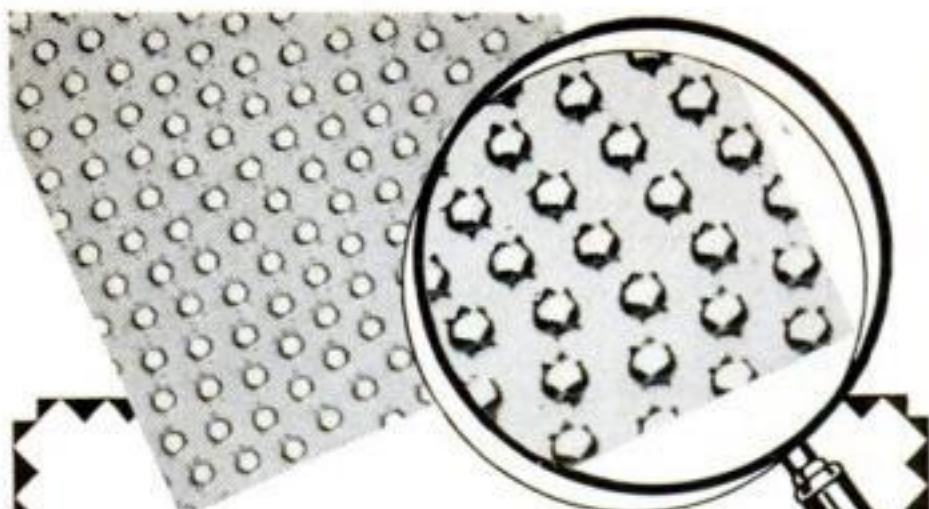
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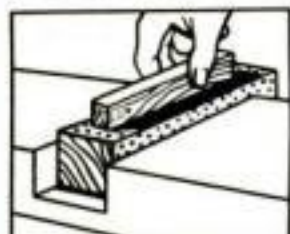
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How to Put Your Good Ideas on Paper

since you've just written a concluding statement, you've set up a target. Make the main section drive straight toward it. Don't include anything that doesn't further the drive.

Finally, sit back and ask one last question: So what? Why should this particular man or group of men be interested in what I've just written? When you have the answer, put it into the first paragraph.

You can shape this opening hook in many different ways. Among them:

- **Promise something of value:** "This report will show how the company can get better use out of the truck pool . . ."

- **Use subtle flattery:** "I'd like to ask your help with a difficult problem . . ."

- **Arouse curiosity:** "Our investigation of stamping equipment has turned up some startling results . . ."

Personality

"Give him a typewriter," says a writing manual published by Johns-Manville Corporation, "and the average nice guy can manage to sound like the most pompous, thundering bore who ever lived."

The reasons are Academic English and Business English—long words, tangled sentences, mossy phrases—and the disastrous notion that you should not write naturally, the way you speak. "Any piece of written matter," says New York Life Insurance Company's Mason, "is a communication between human beings. It should sound like one. Business English is a monstrous mistake, and the sooner it's buried, the better."

When you meet a man face-to-face, you don't snap to attention, eye him woodenly and say: "Reference is made to our telephone conversation of the 15th, and am pleased to advise in connection with same that pursuant to your request, delivery of subject tools will forthwith be made." Instead, you grin and say: "We're delivering those tools you asked for."

Write as you talk, urge the experts—as you personally talk. If you try to make your language fit someone else's standards, or abandon your own language for Business English or some other jargon, the result will be dead matter with none of your personality in it. "Your reader is a human being," says one expert. "Outside of himself, nothing interests him more than other human beings. If your

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How to Put Your Good Ideas on Paper
writing sounds as though it were done by a machine, he'll be bored or downright irritated."

Even the U. S. Government, never noted for the warmth of its correspondence, has discovered the importance of personality. A booklet put together in the National Archives, "Plain Letters," urges federal employees to shun "gobbledygook" and write in their own living English. Make your reader feel you enjoyed writing to him, the booklet advises.

You may have trouble putting personality into your words because, when you sit down to write, you freeze up. These tips from the experts may be helpful:

- Don't be afraid of the personal pronouns, "I" and "you." Never say "the undersigned writer" or any similar nonsense when you mean "I." Never dodge the question by writing "It will be noticed" when you mean "You'll notice."

- Don't be shackled to formal grammar. For instance, you were probably taught in school that it's wrong to ever split an infinitive or use a preposition to end a sentence with. "This is the sort of impertinence," Winston Churchill once remarked, "up with which I will not put." These arbitrary rules are "hangovers from yesterday's usage," says Mason. The English language is alive and changing, and what may not have been acceptable 20 years ago may be fine today.

- Don't be afraid to abbreviate. Instead of writing "I have not," write "I haven't"—just as you'd say it.

- If you come to a point where a slang word or colloquialism expresses your meaning better than anything else, go ahead and use it.

- Avoid the wishy-washy tone that comes from too much use of the passive voice. "The report was signed by the president" is a passive statement. Make it active: "The president signed the report."

None of these pointers will make you into a Shakespeare. But they'll help you make yourself understood and get the responses you want. Equally important, they'll help your letters and reports present you as the kind of crisp, clear-thinking, decisive fellow who could one day be boss.

END

This is the second article in a series on the Science of Personal Success. The next will appear in the November issue.



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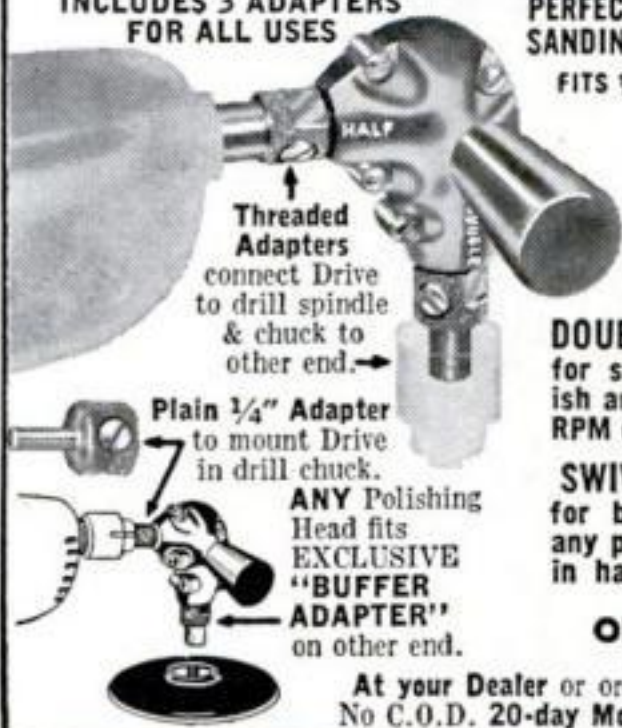
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New Way to Teach Modern Science

[Continued from page 146]

certified genuine, but carefully cast—homey Henry Fonda types without beards or foreign accents. This is apparently intended to implant in young minds the idea that physicists are not witch doctors but All-American Boys grown up. The exchange of one false stereotype for another is ironic. A quick glance around PSSC offices convinces you that physicists are just people and come in all varieties; some look and talk like Midwestern fullbacks while others have flabby paunches, beards, and Middle European accents.

The books. Despite all that is crammed into the text, added and amplified in the films, there is much more physics that high-school students might be taught. The text suggests additional outside reading, but even this did not satisfy the PSSC. So the Committee has gone into the paperback-book-editing business in a characteristically big way.

More than 100 paperback "monographs" are now planned. Each book covers one special corner of physics and is being written by a top man in that field: Fred Singer on "Space Flight," Vincent Schaefer on "Weather," Bruno Rossi on "Cosmic Rays," for a sampling. Heavy editing by a staff including Paul Brandwein, Gerard Piel, Samuel Goudsmit, and Phillippe LeCorbeiller makes sure they come out clear, understandable and fun to read.

The first few should be off the press early next year. Cost is under a dollar, length 20,000 to 40,000 words. Doubleday will publish them and supply book stores, but since teen-agers seldom hang around book stores, the Wesleyan University Press will inform them through a direct-mail campaign. The youngsters won't be forced to buy the books, but there's little chance that they will fail to hear about them or will have trouble getting them.

The teachers. First off, there aren't enough of them. Second, many of them lack formal education in the modern physics they are now expected to teach. So the PSSC is tackling this job, too. And again, in the big way. It hopes to "retrain and refresh 10,000 physics teachers through whose classrooms pass 300,000 students each year."

Zacharias says, "The students will ask

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a great many simple-minded questions. They are the most important but they are sometimes hard to answer. The edge in knowing the right answers should be given to the teachers."

Here is how the teachers will get that necessary edge:

- A teacher's guide—a special textbook for the teacher—will spell out good answers for simple-minded questions.

- Teachers who want to use the course during the experimental trial period will first have to go to school themselves, preferably attending a six-to-eight-week summer session (there were five sessions last summer) but at least studying evenings in classes during the school year.

How good is it? The new physics course was tried in eight schools (300 students) last year. The conclusion: "The more able [students] profited immediately . . . the less able have grown remarkably in general understanding."

This trial, however, was admittedly loaded. Most of the schools were whiz-kid factories (Bronx High School of Science, Phillips Exeter Academy). The big test now going on covers a more representative cross-section of the U. S. and should turn up solid information.

A great many educators, inside and outside the PSSC, have been examining the course as it develops. Their reaction is mostly enthusiasm, although there is some criticism, which might be summarized this way:

- The course puts an extra load on already overburdened schools. Teachers will need extra time. And the expense will be greater. The books cost a little more. So does the lab equipment (all those razor blades add up). The complete set of movies could cost a school a shocking \$8,000 (however, rental plans and cost-sharing schemes are being worked out).

- The course leans over backward too far in avoiding all the how-it-works explanations of modern machines. This is not only part of the fun of physics, but also an aid to learning—the teacher can start with something familiar (a gasoline engine) and then lead into the unfamiliar physical laws that make it work. Actually science itself often follows this pattern, deducing the fundamental laws after the practical invention (Watt invented

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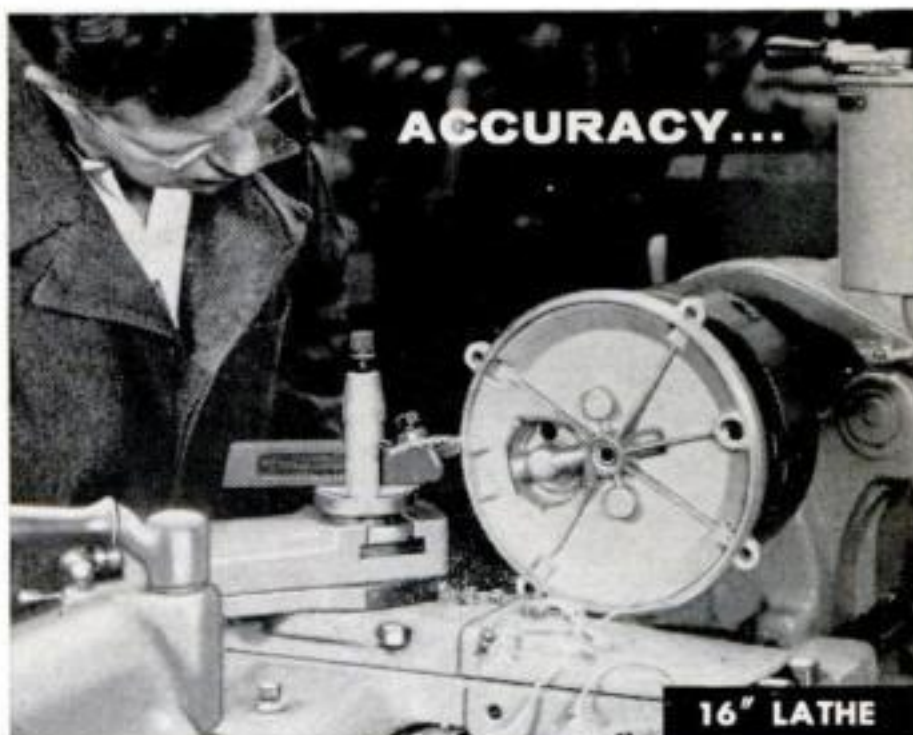
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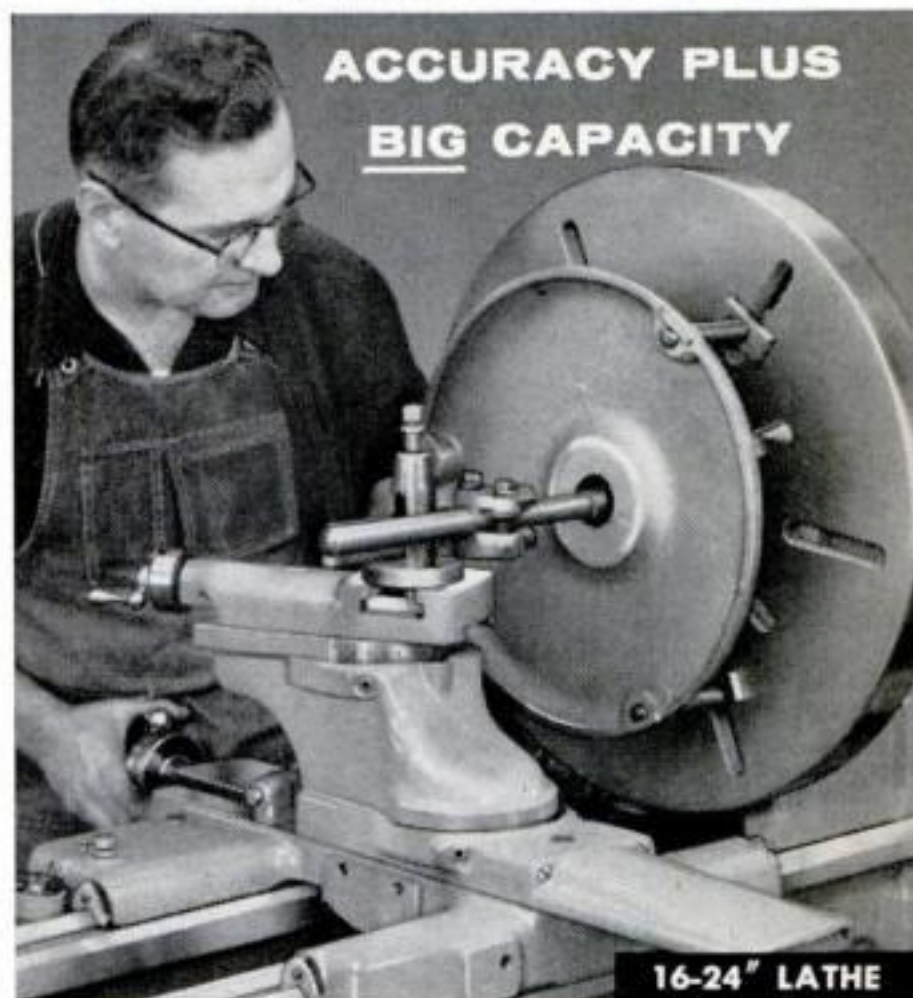
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To such criticisms, a PSSC staffer replies, "We can't do everything. We set out to put real physics into the high school, within the present educational pattern. If we succeed at that we'll be happy—and then we'll think about going further."

What next? Although the PSSC "experiment" is still unfinished, its quick and apparently worthwhile results are already influencing other areas of education. Mathematics, for instance.

Programs for modernizing high-school math have been under way at the University of Illinois and the Educational Testing Service. Illinois is pushing the theory of sets (groups of numbers meeting specified requirements) as a better way to establish the concepts of algebra and geometry. ETS is mainly aiming for a high-school course in statistics, knowledge of which is practically essential nowadays in every line of work from mass-production metalworking to medicine.

These are comparatively modest efforts. But last summer a big-scale effort got rolling at Yale. It apparently will emulate the physics project, pulling together all the experts in the country for a complete stem-to-stern overhauling of math.

In the wind is a similar attack on chemistry (PSSC, which considered combining chemistry and physics into one two-year course, has an eye on this field). Then there's English, history, and on through the curriculum and down the grades to kindergarten.

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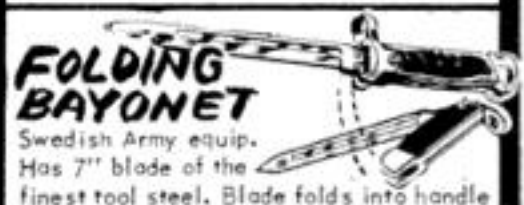
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[Continued from page 106]

ed ramjet missile should be streaking through the air under atomic power.

Unlimited in range, the H-bomb-carrying Project Pluto missile will skim close to earth, virtually "invisible" to radar-warning stations. It will fly so many times faster than sound, that its skin will have to be artificially cooled to counter heating by air friction.

Like other ramjets, the Pluto missile will be launched with rocket boosters, to get it up to the speed at which a ramjet engine works. That sidesteps radioactivity problems at launching.

Called essentially a "barrel poked full of holes," the reactor will heat air passing through it, replacing the burning fuel's flame in a conventional ramjet. Developing this engine is the aim of the Project Pluto team headed by Dr. Theodore Merkle, at the AEC's Livermore Laboratory. Like the rocket reactor, it will be quite a torrid affair. Probably it won't run quite as hot—3,600 degrees may be enough—but its materials must stand up much longer.

They're taking to Nevada their first reactor, already tested in the cold at Livermore, to put it in a 1,300-degree oven and see how its behavior changes. More like an actual engine will be their second reactor, called Tory 2. While it won't fly, they say it will be "a scale model, nuclearly and material-wise" of the one that will, whose feasibility it's to confirm.

Spacemen foresee other uses for a ramjet A-engine. Suppose you want to put a satellite in orbit close to the earth—where air drag soon would bring it down, unless there were some way to give it a push now and then. A ramjet A-engine in it could furnish the push.

For some time it's been known that the Air Force plans a huge Atlas-launched cone-shaped, TV-eyed reconnaissance satellite, popularly nicknamed Big Brother and now officially called Sentry. But where it would get enough power for its TV (1/10 to two kilowatts, by various estimates) has been a mystery, since ordinary batteries are heavy and too short-lived. Speculation has included solar cells, a solar boiler, and nuclear power (PS, Feb. '58).

Recent disclosure of Project Snap (satellite nuclear auxiliary power) lets out

the secret of which was right. Providing *nuclear power* for Big Brother, it now comes out, was the specific assignment that started Project Snap.

The project's experimenters, by now, have come up with three miniature designs for satellite A-power plants:

The heat of a radioisotope from Savannah River's reactors, cerium 144, drives rotating machinery in Snap I. A 200-pound Snap I would generate one kilowatt for at least a year.

Snap II uses a thermal reactor—which, in undisclosed fashion, can deliver up to 1,000 kilowatts. It's being developed by Atomics International for the AEC.

Snap III—the midget of the family, called suitable to run the instruments of a modest Vanguard-style satellite—has no moving parts. Its heat comes from another isotope, polonium. But it turns the heat into current with little pellets of "mixed valence oxides" forming thermocouples, of secret new Westinghouse-developed design, which are expected to attain revolutionary 25-percent efficiency. A Snap III yielding three watts for six months weighs only 10 pounds; at least one of these, it's indicated, has already been built.

Auxiliary A-power for satellites may find military uses besides running instruments. There's talk of a satellite that could nudge itself repeatedly into a new orbit, lest an enemy destroy it by throwing sand or pellets in its way. First he'd have to predict its course, and the zigzagging would baffle him.

What's planned for Project Snap in Nevada hasn't been told. But the test facilities that it's asked Congress to provide—including two reinforced-concrete test cells, and a 15-ton gantry crane "to service the hot-waste storage area"—hint it's a sizable operation.

Along with the three newly revealed projects for flying reactors, our earlier-known program for an A-powered airplane continues. Whether recent test results justify speeding its pace, which some in Congress have criticized as too leisurely, will be decided soon. Perhaps they'd better hurry, if an A-plane is to get off the ground before an A-powered rocket, missile or satellite goes whizzing by.

END

This One



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Dr. Claude Shannon, known to the readers of "POPULAR SCIENCE" for his invention of the electronic mouse, that runs a maze, learning as it goes, formerly a research mathematician for Bell Telephone Laboratories is now a research associate at MIT. His books include publications on Communication theory and the recent volume "Automat Studies" on the theory of robot construction. He has prepared a paper entitled "A Symbolic Analysis of Relay and Switching Circuits" which is available to purchasers of the GENIAC. Covering the basic theory necessary for advanced circuit design it vastly extends the range of our kit.

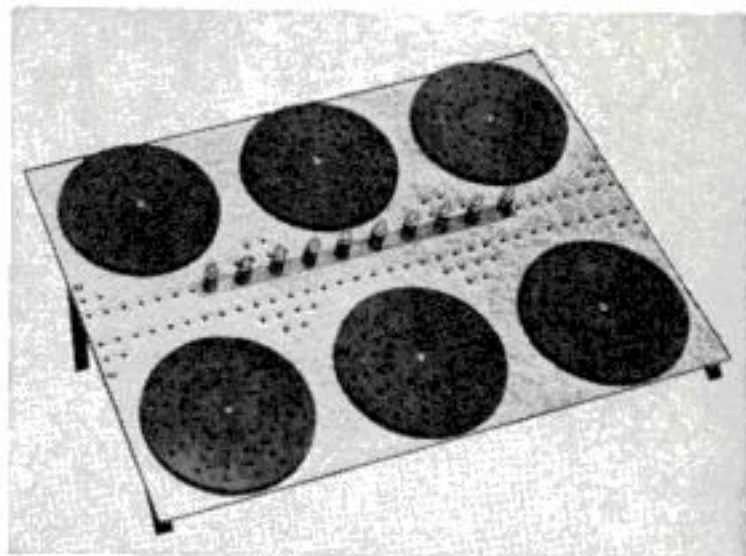
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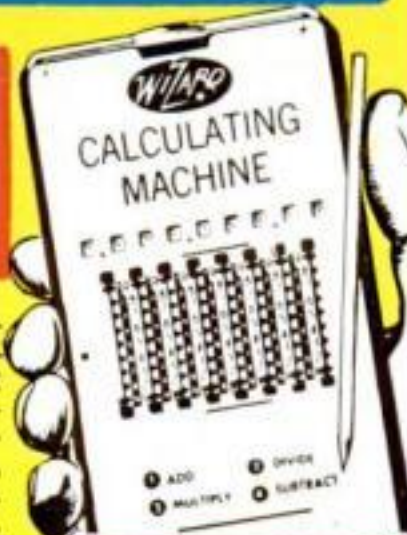
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